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I.

A FEW THOUGHTS CONCERNING THE PATHOLOGY OF ACUTE TONSILLITIS.

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In this paper I shall deal only with acute tonsillitis, that condition which is characterized by swelling of the tonsils, soreness and congestion, and which is generally associated with the presence of purulent exudate issuing from the crypts of the tonsil. Investigations as to the bacteriology of this condition have shown that it is not a specific inflammation, in that it may be due to several varieties of pyogenic organisms. In the more severe forms the streptococcus pyogenes is generally found, while those accompanied with a large amount of exudate are generally due to the staphylococcus pyogenes aureus or albus. The pneumococcus is found in about five per cent of the cases and occasionally the bacillus coli communis. Mixed infections are more common than are infections with one variety of organism.

Goodale, of Boston, recognizes two forms of tonsillitis. The first is a diffuse inflammation of the parenchyma of the organ with increased proliferation of the lymphoid cells, and of the endothelial cells of the reticulum. This form of tonsillitis, he says, is due to the absorption of toxins formed in the crypts. The second is a suppurative process and results from the penetration of bacteria into the tonsillar parenchyma. The suppuration appears as circumscribed abscesses, starting in the follicles and eventually discharging in the direction of least resistance, namely, into the crypts. Outside of this work of Goodale's, I have not met with any scientific study of the histology of inflammatory changes peculiar to the tonsils.

My own observations have been on tonsils removed during life. In one case, I removed badly inflamed and suppurating tonsils from a boy in order to give him sufficient room to breathe, though the concomitant general edema of the pharynx necessitated a tracheotomy a few hours later. The tonsillar wound healed remarkably well, and the patient recovered very quickly after the operation, and there was not excessive hemorrhage.

To understand the pathology of acute tonsillitis, it is necessary to recall the histologic anatomy. The supporting framework of the tonsil consists of the fibrous capsule, connective tissue trabeculae and reticulum. The parenchyma of the tonsil is made up of the germinating follicles and the interfollicular tissue. The crypts of the tonsil are invaginations of the surface, lined with a specialized epithelium, the ramifications of which extend to all portions of the organ. There is very little or no subepithelial connective tissue as far as the crypts are concerned. The function of the germinating follicles is the production of lymphoid cells from what is probably the mother cell of the leukocytic group. The interfollicular tissue is the pathway through which the lymphoid cells gain access to the efferent lymphatics. The experiments of Goodale, Hendelsohn, Kayser, Pierera and Wright with dust particles, have shown that there is a definite current in the interfollicular tissue, tending toward the lymph vessels in the connective tissue trabeculae. The most peculiar feature of the tonsils is the cryptal epithelium. I myself believe that there is a direct change of the epithelial cells of the crypt into lymphoid cells.

Inflammation may be defined as the reaction of tissue to an

irritant. This irritant, in a large majority of cases, is the result of bacterial life. The first visible change in the tissue is probably the appearance of polymorphonuclear leukocytes migrating from the blood cells toward the source of irritation. In a large majority of clinically normal tonsils it is possible to find in some of the crypts numerous polymorphonuclear leukocytes associated with the desquamated epithelial cells, and these leukocytes can be seen migrating through the walls of the crypt. This must be looked upon as an early manifestation of an inflammatory reaction, and its cause is probably the numerous bacteria occupying the lumen of the crypts. This simple diapedesis of the leukocytes is frequently not accompanied by other inflammatory changes, and the condition may be simply a protective reaction, the bacteria in the crypts being destroyed by the migrated polymorphonuclear phagocytes before causing further injury.

If the toxin manufactured by the bacteria in the crypts is virulent, its first point of attack is necessarily the cryptal epithelium, and the reaction of the epithelium to this irritant is manifested by the proliferation of its cells. This is seen in the increased desquamation, the increased penetration of the cells into the tonsillar parenchyma and the presence of mitosis. It is an open question whether as long as the epithelial cells retain their vitality, bacteria which produce acute reaction can penetrate as living organisms into the tonsillar parenchyma. It seems probable that under certain circumstances they can, but in the large majority of cases they gain access to the tonsillar parenchyma only after their toxins have destroyed the epithelium. When the bacteria have gained access to the tonsillar tissue, they find permanent lodgment only in the germinating follicles. The current in the interfollicular tissue tends to carry the bacteria toward the efferent lymphatics. If they are not destroyed by the surrounding cells before they reach the efferent lymph vessels they pass on to the neighboring lymph glands and are there destroyed, producing the lymphadenitis which is associated with all severe cases of tonsillitis. The lodgment of bacteria in the germinating follicles causes the local reaction which may go on to abscess formation with rupture into the crypt.

In acute tonsillitis the cellular constituents of the tonsils change in number more than in variety. In the normal tonsil we find large numbers of lymphocytes occupying the interfol-

licular tissue. In the follicles there are large lymphoblasts which are dividing by mitosis and giving rise to the smaller lymphoid cells. In the epithelium we have all the stages of transitional forms from the epithelial cell to the lymphocyte. These constitute the normal essential cells, but in addition to these we find in tonsils, which are clinically normal, a few polymorphonuclear leukocytes chiefly in the neighborhood of the crypts, a few plasma cells and an occasional eosinophile. Also in the follicles one may sometimes find large cells which are probably derived from the endothelium of the connective tissue epithelium.

In an acutely inflamed tonsil we find proliferation of nearly all the cellular elements, and in addition various forms of leukocytes derived from the blood. The phagocytic cells found in acute tonsillitis are probably in greater part derived from the polymorphonuclear leukocytes. These cells are phagocytic both to cellular debris and bacteria, and are found in the tonsillar substance as well as in the crypts. In the substance of the tonsil and much more frequently in the interior of the follicles, large phagocytic cells exist which, according to Goodale, are derived from the endothelium of the connective tissue reticulum. They are not, however, the counterpart of the endothelial phagocytes which one sees in acute proliferative inflammation of the lymph nodes, nor are they nearly so numerous. The lymphoid cells may become enlarged developing into macrophages which are phagocytic to cellular debris, but probably not to bacteria. The eosinophiles are greatly increased in number in acute tonsillitis and are most numerous where the cryptal epithelium is being most rapidly destroyed.

SUMMARY.

From a pathologic standpoint we can recognize three types of acute tonsillitis: A proliferative form with increase in nearly all of the cellular elements of the tonsil; a lacunar form, in which the cryptal epithelium shows the most severe lesions; and a suppurative form in which abscesses develop within the germinating follicles. These different forms are generally associated together in a given case, but anyone of them may be the predominating lesion. Certainly in all cases we have a proliferation of the cellular elements, and very early in the process there is associated some diapedesis of multinuclear

leucocytes through the cryptal epithelium and possibly some necrosis of the epithelial cells. If necrosis of the cells is great enough to cause a break in the epithelieum, the parenchyma of the organ is open to attack, and the bacteria gaining access to the tonsillar tissue probably find lodgment in the follicles and there cause intrafollicular abscesses.

In closing it may be well to say a word concerning the forms of tonsillitis as they can be recognized clinically. We certainly can differentiate between a simple proliferative tonsillitis in which the tonsils are swollen and reddened, and a suppurative form in which the swollen reddened tonsil shows the presence of exudate, either purulent or membranous, coming from the crypts. It is not possible clinically to differentiate between follicular abscesses discharging into the crypt and necrosis of the epithelium associated with diapedesis of large numbers of neutrophiles. It is better, therefore, to class these two types under the single heading of suppurative tonsillitis.

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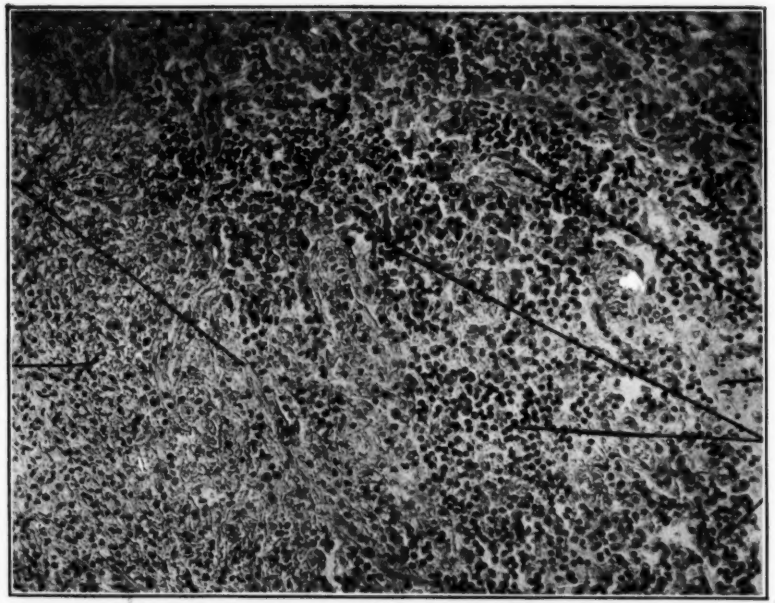
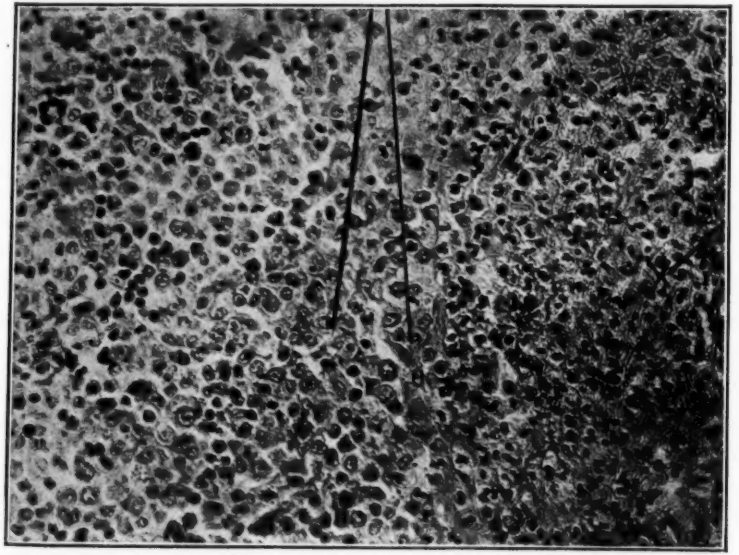


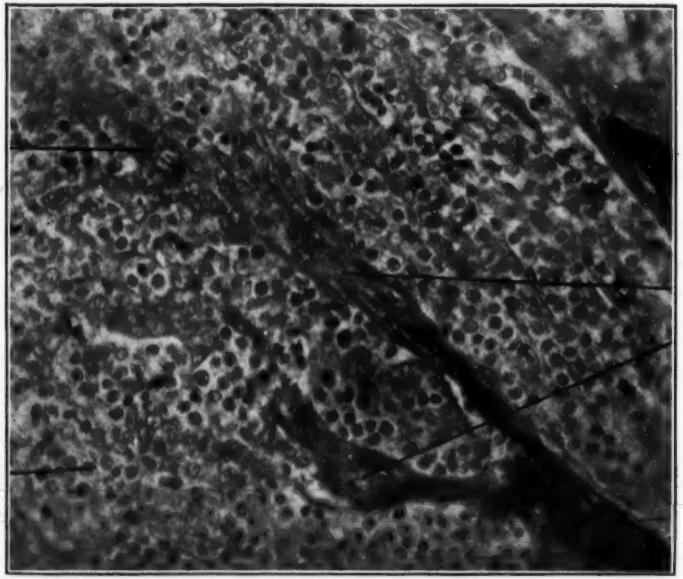
Acute tonsillitis. Extensive ramifications of the cryptal epithelium.

Epithelial cells.

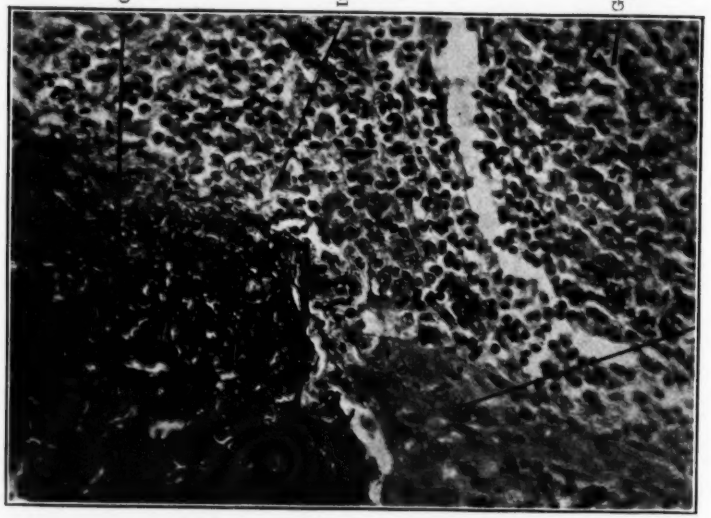


Crypt filled with debris, numerous polymorpho-neuclear leucocytes, fibrin, and broken-down epithelial cells.

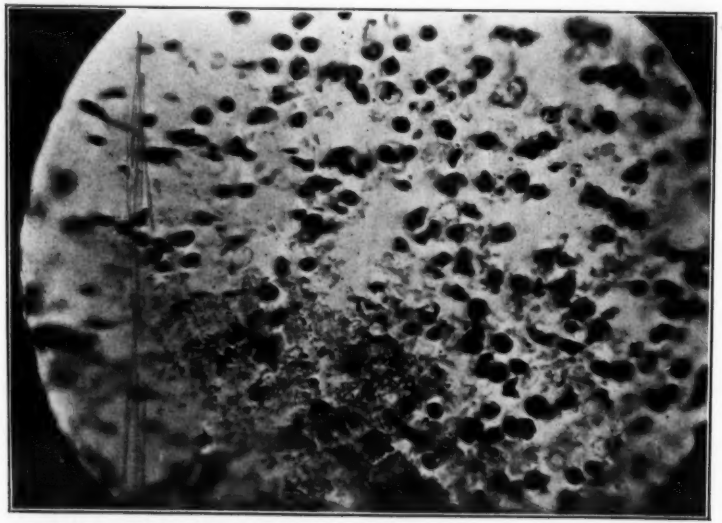
Acute tonsillitis. Invasion of the cryptal epithelium.



Normal faucial tonsil, showing terminal portions of a crypt. Notice the keratosed material in crypt and the penetration of epithelial cells in the tonsil parenchyma.



Acute tonsillitis. Destruction of cryptal epithelium.

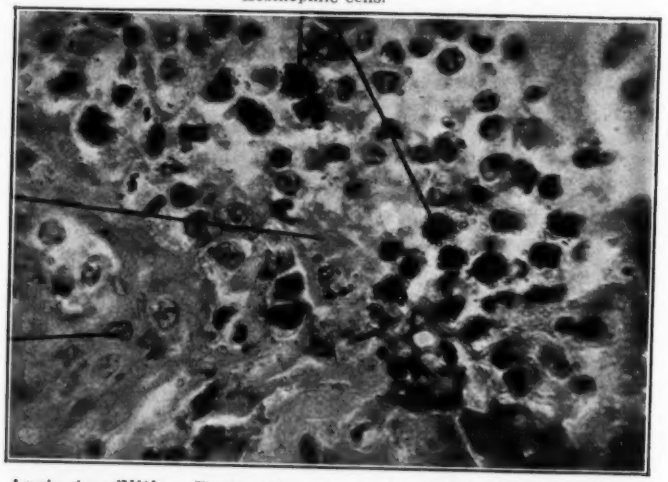


Acute tonsillitis. Numerous bacteria, mostly streptococci and staphylococci, occupying lumen of crypt.

Eosinophile cells.

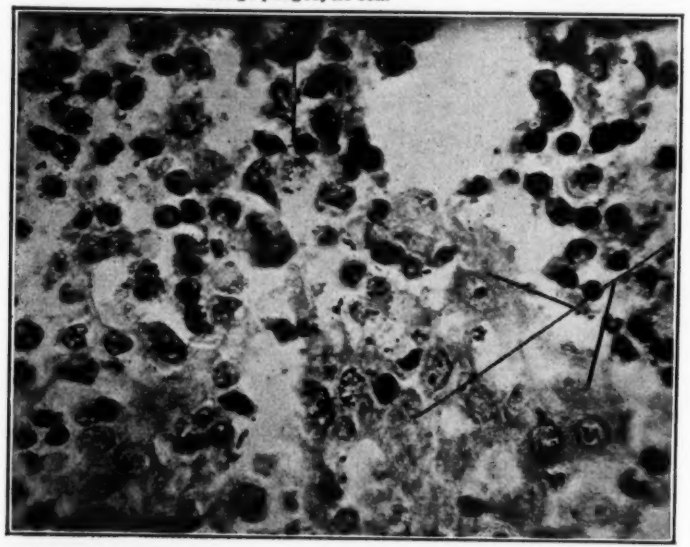
Necrotic epithelial cells.

Living epithelium.



Acute tonsillitis. Destruction of cryptal epithelium. Numerous eosinophile cells.

Large phagocytic cell.



Necrotic epithelial cells.

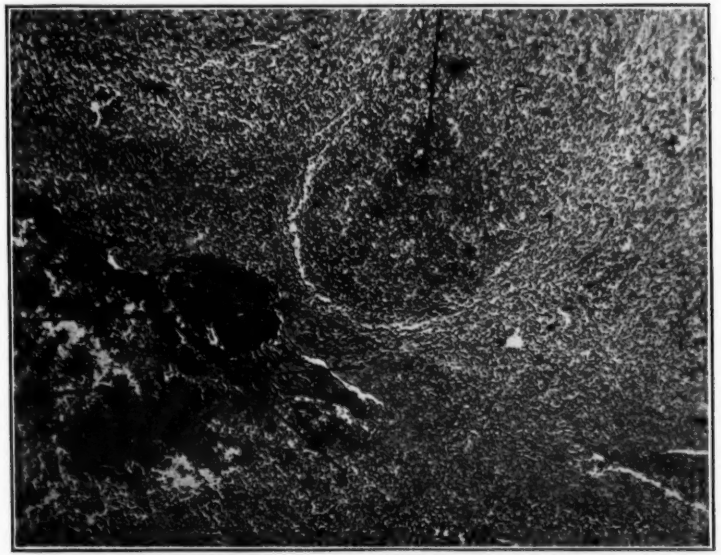
Acute tonsillitis. Necrosis of epithelial cells. Phagocytosis.

Beginning intrafollicular abscess.

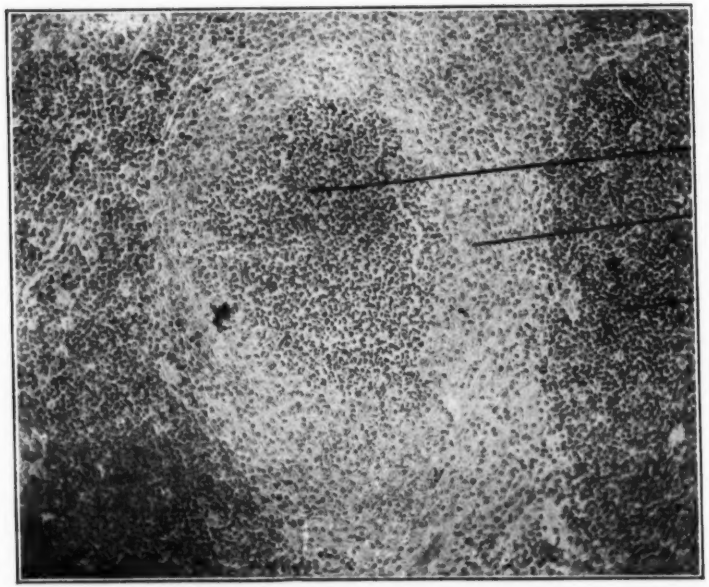
Living epithelium.

Dehiscence in epithelium.

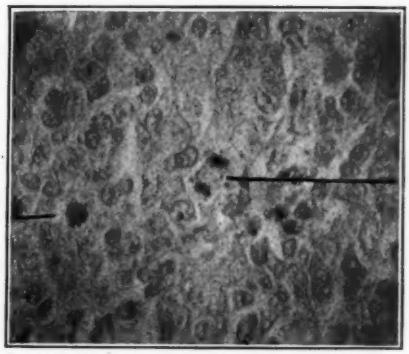
Crypt filled with bacteria, fibrin, polymorphoneuclear and epithelial debris.



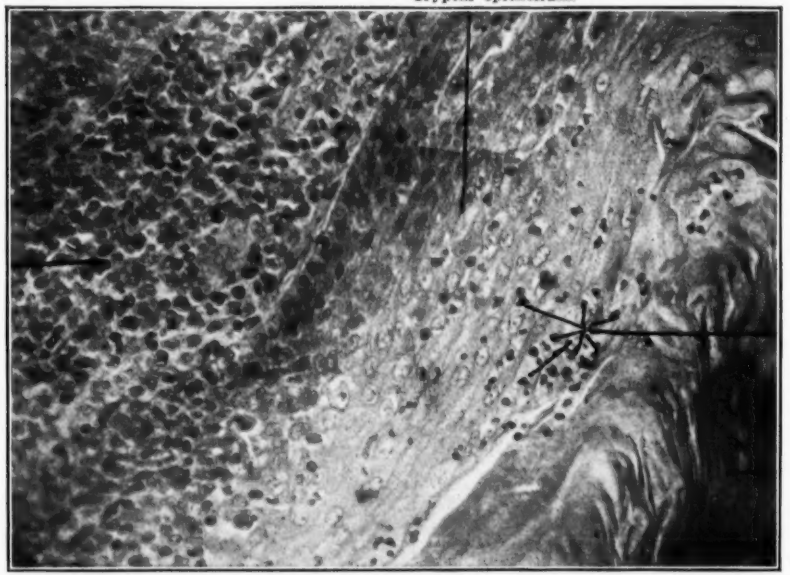
Acute tonsillitis. Destruction of epithelium at one spot permitting access of bacteria to tonsil parenchyma—beginning intrafollicular abscess.



Acute tonsillitis. Intrafollicular abscess.



Cryptal epithelium, showing mitotic division of its cells.



Hyperkeratosis of faucial tonsil, showing exudation of polymorphoneuclear leucocytes through cryptal epithelium.

II.

EXHIBITION OF CASES, ILLUSTRATING THE RESULTS OF THE SO-CALLED HEATH OPERATION.*

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The fact that the various professional periodicals, especially those devoted exclusively to diseases of the ear, nose and throat, contain so many papers repeatedly describing the various surgical procedures for the relief of aural disease, is proof positive that this branch of surgery is still an art, and has not yet assumed the dignity of a science; and yet it is only by repetition and investigation that we finally arrive at certain conclusions which embody the best that the present age has contributed. In other words, it is through the recording of our various mistakes and numerous failures that we are enabled to distinguish between the right and the wrong, and thereby to receive the stimulus of such recognition for better and more accurate work. This is true in point of diagnosis as well as in the improvement manifested in various surgical procedures for the relief of pathologic conditions involving the organ of hearing.

The evolution of operative otology from the time when the first imperfect simple mastoid operation was performed, consisting of little more than boring a hole through the cortex, up to the time when Schwartze, Stacke, and others devised the comparatively perfect radical operation, has shown great strides in a procedure calculated to save the lives of thousands, and in this respect is scarcely secondary to the great boon conferred upon suffering humanity when the operation for appendicitis was first devised.

In the very recent past we have heard much of what might

*Read before the Eastern Section of the American Laryngological, Rhinological and Otological Society, at Philadelphia, Pa., January 9, 1909.

be expected of the so-called Heath operation, especially in its relation to the preservation of hearing. If this procedure, under whatever name it may appear, will succeed in relieving dangerous pathologic processes in the tympanic and accessory cavities, and at the same time insure not only the preservation but the actual improvement of the hearing power, the further evolution of aural surgery has certainly had a tremendous impetus.

On general principles it is difficult for one to accept as good surgical procedure that which advocates the non-disturbance of necrotic tissues, be it either diseased ossicles or carious bone that must necessarily remain in the narrow space connecting the tympanic cavity with the mastoid antrum, and yet this is precisely what is claimed for the Heath operation. In other words, we aim to perform a radical operation, which includes the complete exenteration of the cells comprising the temporal bone, with the exception of the tympanic ring and the fragment of ossicles and membrana tympani which are left undisturbed, as the extent of their necrotic involvement seems to make but little difference in the final result. In my limited experience, some of the more extensive necrotic cases have made the very best recoveries, both in the way of entire cessation of discharge and in more or less complete regeneration of the membrana tympani, while the ultimate restoration of hearing power has been carried to almost normal. On the other hand, I have to report that in some cases of shorter standing, where the necrosis seemed to be limited, I was unable to arrest the otorrhea, due, probably, to my faulty technic; nevertheless, the hearing distance was greatly increased.

In some patients, where to all appearances not even a fragment of drumhead and ossicles remained, the removal of the inflammatory debris within the mastoid antrum, tympanic cavity and aditus, preserving intact the annulus tympanicus, has certainly been the means of arresting a chronic discharge and greatly improving the hearing, without, however, causing a regeneration of the membrana tympani. The principal contention of Heath, therefore, that the mastoid antrum is more frquently the site of a continued suppuration, rather than the cavity of the middle ear, would seem to be substantiated. Such being the case, we can readily realize how easily the narrow, unyielding aditus may become obstructed by pathologic debris, causing the antrum to fill with inflammatory products,

this in turn producing a degree of pressure which may extend upward into the middle fossa, downward into the mastoid process, and backwards towards the lateral sinus.

In the past few years excision of the membrana tympani and ossicles, instead of the usual mastoid operation, has been revived and strongly urged, with a view of curing certain cases of chronic discharging ears. We have felt it our duty, in certain instances, to advise this operation, with a view of arresting the discharge. Obviously, all of us have frequently been disappointed in the results, no doubt owing to the aforementioned fact, that the principal site of the trouble, being located in the antrum, was not reached by an excision of the ossicles, and the operation did not even provide for drainage through an obstructed aditus, which omission in the end compelled us to resort to the usual radical procedure. My more recent experience, therefore, teaches me that the Heath operation, for the reasons above mentioned, will largely supplant that of the excision of the ossicles for the cure of an otorrhea.

I have performed the Heath operation in some cases of acute mastoiditis with extensive bone necrosis, where, owing to the great destruction, I should otherwise have felt obliged to perform the usual radical operation. This was especially true in cases where extensive erosion had destroyed the greater part of the bony external auditory canal, the discharge from the antrum and cells escaping through this opening.

In another class of cases I believe this operation to be of the greatest importance. We all see cases of chronic otorrhea in children involving both ears, where the hearing is practically normal. Some of these cases are persistently unyielding to any line of treatment other than operative. The simple mastoid operation does not relieve the discharge, and in performing the radical operation there is great danger of interfering with audition. If such a condition were present in only one ear in a young child, the gravity of one-sided deafness would not be so great, but suppose we should perform a radical operation on both ears of a child, for the relief of an otorrhea. There is almost a certainty that the hearing will be greatly interfered with, which condition is likely to grow worse. In this event the child, if young, will in all probability become dumb as well as deaf. Even though the aural disease may endanger the child's life, the responsibility of advising a double radical mastoid operation, in view of the possible danger to the hear-

ing power and the consequent loss of speech that may follow, should not be lightly assumed by any surgeon. Another point in favor of this modified operation is that there is less liability of injuring the tympanic branch of the facial nerve, but the most important benefit to be derived from this surgical procedure is the eradication of the danger zone, which is located in the antrum, thus removing the source of a disease most prone to cause intracranial complications.

There are in attendance for your inspection about a dozen cases showing the results of the operation for the relief of the various forms of suppuration, and detailed histories of five of these cases follow:

CASE I. Dr. C. S. H., male, white, age 29 years. Presented himself for treatment on April 1, 1908.

History.—Eighteen years ago, he contracted a suppurative otitis media of the right ear, which has continued to date. Ten years ago, the membrana tympani and ossicles were excised with a view of relieving the otorrhea. This very materially lessened the quantity of the discharge, but it never entirely ceased. For the past year the patient has complained of increasing nausea and vertigo, both in frequency and severity, the continuation of which caused him to seek relief through operative interference.

Examination.—Right ear shows the absence of the membrana tympani and ossicles. The canal is well filled with a non-offensive, yellow, purulent discharge. The roof of the tympanic cavity has been absorbed through carious erosion, exposing the dura.

Operation.—The Heath operation was performed on April 6, 1908. The cortex looked entirely healthy, the entire process having undergone sclerotic changes, being, therefore, quite filled with new bone formation and exceedingly hard. No actual disease of the bone was noted until the antrum was reached, and at this point we found considerable granulation tissue and the exposed dura above mentioned.

The patient made an uninterrupted recovery, the discharge having ceased in six weeks from the date of operation, the membrana tympani regenerating in about the same time.

The hearing, although not in any sense acute, has improved considerably.

The chief point of interest here, however, as in some other cases, is from the fact that the discharge has entirely ceased

and there is a regeneration of the membrana tympani. The patient's general health has improved considerably, he weighing more than at any time in his life.

CASE II.—H. O., male, white, age 16 years. Came to Jefferson Hospital Clinic for treatment on July 23, 1908.

History.—The patient gives a history of having suffered about nine years ago from a suppurative otitis media. It is uncertain, however, how long this continued. The present attack of otitis dates back about two weeks, the patient apparently suffering the usual amount of pain incident to such a condition.

Examination.—The canal of the left ear is filled with a yellowish discharge, offensive in character and streaked with blood. The membrana tympani is largely destroyed, very red and edematous, the inflammation involving the osseous external auditory canal, which bleeds freely on the slightest irritation from a cotton-covered probe. I have no note of the exact condition of the ossicles at this time. The boy hears the tuning fork at about three inches, aerial conduction. Ordinary conversation can be heard only in close proximity to the ear.

Treatment.—The patient was provided with an antiseptic solution for irrigation, returning to the hospital September 29, or about two months later. The examination at this time showed the discharge to be of the same character. There was not at any time during the course of his disease pain over or in the region of the mastoid process, not even on deep pressure.

A skiagraph of the mastoid was taken, and portrayed the process as well filled with pathologic debris.

Operation.—The Heath operation was advised and performed on October 16, or after three months of continuous discharge following the last attack. A separation of the soft parts showed the cortex to be rather hard, but bleeding at several points. The interior of the mastoid process was well filled with granulation tissue and extensively necrotic. There was not, however, very much free pus found. The operation consisted of the complete exenteration of the cells.

The patient states that about one month after the operation he began to notice some improvement of hearing. The membrana tympani has regenerated with the exception of a small pear-shaped opening in the posterior part. The hearing has materially improved. The boy now hears the tuning fork at about eight inches and ordinary conversation at from six to eight feet.

CASE III.—M. W., male, white, age 42 years. Patient first appeared before me on October 12, 1907.

History.—About four years ago, while swimming, he contracted an acute suppurative otitis media of the right ear. The discharge has continued to date. The patient claims that the attack occurred without pain, and that he was entirely free from suffering of any kind until about four weeks before seeking treatment, or about three years and ten or eleven months after the initial attack, at which time he began to have pain in the ear, especially over the mastoid process, which was aggravated by pressure or percussion. The patient also states that this pain was considerably increased by bending forward. The only treatment he has received up to the present time has consisted of syringing the ear with salt water.

Examination.—An examination shows the discharge to be copious, greenish-yellow in character, and very offensive. There is destruction of the lower two-thirds of the membrana tympani, Shrapnell's membrane being intact. The ossicles and landmarks are entirely obliterated on account of the swelling, and there is considerable granulation tissue in the tympanic cavity. No marked bulging of the superior and posterior wall of the external auditory canal is present. There is, however, rather marked tenderness on moderate pressure over the mastoid process, more especially pronounced at the tip.

The patient hears only when spoken to very distinctly and in a loud voice. Tuning fork is not heard by aerial conduction. Bone conduction, however, appears to be fairly good.

Operation.—The Heath operation was performed on October 25, 1907. The patient noticed a considerable improvement in hearing about two weeks after the operation. This improvement was progressive for about four months, he retaining this improvement in hearing power to the present time.

Examination.—January 2, 1908, the membrana tympani in this case has never regenerated. The discharge, however, has entirely ceased. The fragment of malleus and also that of Shrapnell's membrane remain about as they were before the operation. The hearing power, according to the patient's statement, assumes that of almost normal. Hears tuning fork at about four inches and a low voice at about five or six feet.

CASE IV.—E. S., female, white, age 11 years. Presented herself at the Jefferson Hospital Clinic for treatment on November 10, 1908 .

History.—Eight years ago, without known cause, she contracted an acute suppurative otitis media of the left ear, which has continued recurrently to date. The mother states that the discharge is usually less during the warm weather.

Examination.—Examination shows the canal well filled with thick, yellowish pus, without any particular odor. The membrana tympani is practically destroyed except Shrapnell's membrane. There is marked redness and some edema of the external auditory canal, especially the superior and posterior part adjacent to the tympanic ring. There is no pain over the mastoid, even on deep pressure. The child has great difficulty in hearing at school, it being necessary to place her near the teacher so she can properly receive instruction.

Operation.—The Heath operation was performed on November 17, 1908. The exposed cortex was found to be practically normal in appearance, but unusually hard and thick. The entire mastoid cells, however, were necrotic, which required their complete removal. The sinus was more superficial than normal and pushed far forward.

Six days after the operation the patient was discharged from the hospital and returned to the Out-Patient Department for the usual dressings.

The mother feels that the hearing has gradually improved somewhat, although she lacks the marked improvement that is shown by some of the other patients. The discharge, however, has entirely ceased and the membrana tympani has regenerated.

CASE V.—H. D., male, white, age 18 years. Came to Jefferson Hospital Clinic on October 11, 1907.

History.—Family history good. Only disease from which patient has suffered is whooping-cough, which is said not to have had any influence on the aural disease. Has suffered from a recurrent suppurative otitis media of the right ear from infancy, the trouble recurring at intervals ever since. Pain is worse during the period of cessation of discharge. The last exacerbation occurred about two years ago, causing severe suffering. The discharge continued uninterruptedly until patient came to the clinic. With each acute exacerbation the patient becomes quite ill, and before the appearance of the discharge suffers from high fever, nausea and vomiting, severe headache, and great prostration. The hearing power is very much impaired, the patient involuntarily turning the good ear toward

the speaker, feeling that the right ear is more or less useless for ordinary conversation.

Examination.—Examination at this time revealed a discharge in the external auditory canal, the greater part of the membrana tympani being destroyed. The history of the case does not define the character of the secretion nor state definitely as to the presence of granulation tissue in the tympanic cavity. Deep pressure over the mastoid process elicited some tenderness.

Operation.—The Heath operation was performed on December 6, 1907. The mastoid process was found to be of the diploic variety, the accompanying osteomyelitis extending backward beyond the mastoid bone. The cells were extensively necrotic, the carious erosion exposing the sinus for almost its entire length.

The boy was entirely well about six weeks following the operation, that is, the discharge had ceased, there was a complete regeneration of the membrana tympani and the hearing power had improved almost to normal, the patient reporting that he was free from all discomfort.

Examination.—January 2, 1909. Improvement has continued uninterruptedly, and if anything there is still further betterment in hearing and the entire absence of any discharge. Hears ordinary conversation at from twelve to fifteen feet.

Notwithstanding the fact that the results seem to justify this surgical procedure in certain cases, yet it is most difficult to reconcile myself to the belief that it is sound operative technic to deliberately retain pathologic products, however minute, within the organ of hearing. However, as you will see from the cases present for your examination, the results generally are good and in some instances brilliant. Therefore, the manifest betterment of the aural condition of the patients compels us to give some recognition to this procedure, and at the same time serves to stimulate us to still further investigation.

Generally speaking, the operation should not be performed in the presence of suppurative or necrotic diseases of the labyrinth, where cholesteatomata are present within the cavities of the tympanum or antrum, or abscess formations involving the interior of the skull, especially if the infection gains entrance through the tegmen tympani.

On the other hand, we would feel inclined to advise the operation in appropriate cases, from the fact that it does not interfere with the membrana tympani and ossicles, thereby not jeopardizing the power of hearing. It would seem best, as a rule, for this reason, that the operation be performed early, before the disease has caused much destruction of the conducting apparatus. Some other points in its favor are that the danger of injury to the facial nerve is very much reduced; the shock from the surgical procedure is considerably lessened; and the recovery is notably quick, while at the same time it corrects the pathologic process within the danger zone, the antrum.

This procedure, furthermore, not only preserves the hearing present at the time of operation, but actually improves it to a noticeable degree, in the majority of cases. Then, again, it is suitable in both the acute and chronic variety of cases, and will probably supplant the operation known as ossiculectomy for the cure of an otorrhea.

III.

SOME POINTS IN ANATOMY, PATHOLOGY AND SURGICAL TREATMENT OF THE FAUCIAL TONSIL.*

By Joseph C. Beck, M. D.,

Chicago.

The purpose of this paper is to dwell on the anatomy, pathology and surgical treatment of the faucial tonsil only in so far as it is necessary in the operation of complete enucleation of this structure, based upon personal experience in a large number of cases during a period of four years. (Previous to this time I had never performed a complete enucleation.)

Almost any modern text-book on nose and throat diseases treats the subject of the tonsil in a satisfactory way, and from the point of view of a radical procedure in its removal the one of William L. Ballenger is to be highly recommended. In light of that fact it seems superfluous to add another paper on this subject, if nothing new can be presented. Beyond a slight modification in the technic of the operation, extensive macroscopic and microscopic study of tonsils removed from patients who had distinct tonsillar diseases, or diseases depending on tonsillar affections, I have nothing but corroborating statements to make. At the same time, I am sure that this subject needs to be brought before the medical profession constantly, especially the general practitioner, because too many diseased tonsils are allowed to remain in the throats of individuals, especially adults, causing not only local disturbances, but general toxemias and secondary infections. Again, when these diseased tonsils are recognized, they are often improperly managed by local applications or incomplete removal. The great but unwarranted fear of hemorrhage is what stands in the way, and yet, if the technic is understood, it is very, very rare; I have always been able to control it without difficulty.

*Read before the International Medical Congress at Mexico, January, 1909.

GROSS AND HISTOLOGIC ANATOMY.

Most of the text-books and articles written on this subject are based on the studies of tonsils removed from the cadaver or animals, and as far as the capsule is concerned, the literature is not very extensive. H. A. Barnes, of Boston,[1] has recently published an article on the study of the capsule of tonsils removed from patients suffering from tonsillar disease. Histologic sections were made and his findings are so much like mine that I will not repeat them here, but refer to my own sections. This is about the first article in the direction of the study of the capsule and of tonsils removed from patient, that has come to my notice. My own studies are based on about two hundred tonsils removed (for pathologic conditions) with capsule attached, and examined macroscopically and microscopically, in order to determine the structure of the capsule, muscle tissue, vascular distribution, particularly the location of entrance of the tonsillar artery, the lymphoid and connective tissue framework, also the pathologic conditions, which will be described separately.

I have further studied the vascular supply of the tonsils by injecting the arteries on one side and the veins on the other in a very fresh cadaver by means of a lead solution. Removing both tonsils thus injected I took stereoscopic radiograms of them and demonstrated the rich supply of vessels.

Before describing the tonsils removed, I desire to call attention to some of the landmarks which are important in the operation.

The structures surrounding the tonsil and intimately connected with it are:

1. Margo supratonsillaris, which is a mucous membrane that can be made out very clearly at the uppermost portion, where the anterior and posterior pillars join one another when the tonsil is drawn from its bed towards the median line.

2. Plica tonsillaris or triangularis, which can be traced from about the lower half of the anterior pillar obliquely backwards and downwards, covering the lower one-third of the tonsil, and gradually lost in the posterior pillar, and the palatoglossal fold. This plica is not always present in this form and size. In some cases it is so markedly thickened and

[1]Boston Medical and Surgical Journal, September 24, 1908.

developed as to cover more than two-thirds of the tonsil, and again it may be so attenuated as to be practically wanting.

3. The anterior pillar.
4. The posterior pillar.
5. The retrotonsillar areolar tissue, fascia and muscles of the pharynx.

I consider primarily two divisions of the tonsil, namely, (a) the exposed part; (b) the hidden part. The hidden part is again subdivided into three, namely, (1) the vilar or head; (2) intrapillar or body, and (3) subplicar or tail.

These subdivisions are purely arbitrary and are used for description of the radical operation.

The exposed portion which is covered by mucous membrane is seen to be marked by small depressions, corresponding to the openings of the crypts. The number and size vary a great deal. The largest ones are found in the upper portion of the tonsil. At times they may be covered over by the margo supratonsillaris. I have seen a colored paste injected into one of these openings, escape through one or more of the other crypts, which would indicate that they communicate, a fact not very well known and not shown clearly on histologic examination.

Of the hidden part of the tonsil, the vilar or head appears to be the largest. It not infrequently happens that in a flat tonsil, after the margo supratonsillaris is incised, a large mass comes into view, if sufficient traction is made upon the tonsil. This portion is less firmly connected to the surrounding loose areolar tissue. The intrapillar or body portion of the tonsil is usually much smaller and more firmly adherent. It is within the lower half of this portion that the main artery enters the tonsil and bleeding is usually encountered at this point.

The subplicar or tail portion of the tonsil is the smallest, although I have seen it larger than either of the other parts of it, and reaching very low down below the level of the base of the tongue. This portion is very intimately connected with the surrounding structures and large veins, and some smaller arteries enter it from the anterior and posterior pillars, as well as from the palato-glossal fold. This portion has few crypts and most of them are covered by the plica. In methods other than the enucleation operation this portion of the tonsil most frequently remains in the pharynx.

The cavity created by the radical enucleation operation of the tonsil may be considered anatomically about as follows: The anterior and posterior pillars stand out very prominently, and appear thin. At the bottom of this cavity, which always looks larger than the structure removed, one can see the constrictor muscles of the pharynx and number of shreds of the severed loose areolar tissue, especially at the lower region, several points of oozing, denoting the severed blood vessels, and at times a spurter at the lower third of the cavity. I shall speak of this cavity again under post-operative treatment, and ultimate results of the operation.

MACROSCOPIC STUDY OF A RADICALLY ENUCLEATED TONSIL.

If the operation was performed *lege artis* successfully, then the entire gland is preserved and in good condition, that is, not torn to pieces by the volsellum forceps, or cut into by the knife. The hidden portion is completely enveloped by a firm fibrous capsule, which merges into the mucous membrane of the severed margo supratonsillaris, anterior and posterior pillars. and plica triangularis, which are taken along with the dissected tonsil. Attached to the outer surface of the capsule are found the severed shreds of areolar tissue and some muscle fibers. I have not been able to positively determine macroscopically the entrance of the main artery through the capsule, even by the aid of a strong magnifying lens. A blunt-pointed probe inserted into the crypts will find them in most instances right against the inner surface of the capsule. If this probe penetrates without resistance through the capsule, then one can assume that the operation was not radical; that at least part of the capsule and perhaps tonsillar tissue were left behind in the fossa.

MICROSCOPIC STUDY OF A RADICALLY ENUCLEATED TONSIL.

(Fig. 1. Natural color photographs can not be demonstrated under low power.)

Sections of many tonsils that were removed on account of tonsillar disease, most frequently of a chronic lacunar inflammation, were made both in the horizontal as well as perpendicular plane, and they show the following:

1. Mucous membrane margin of the margo supratonsillaris,

anterior and posterior pillars and plica triangularis. These are distinctly adherent.

2. Fibrous capsule of variable thickness.

3. Trabeculae of connective tissue (framework), starting at the inner surface of the capsule, and running towards the mucous membrane surface in an irregular manner.

4. Lymphoid tissue masses situated between the above-mentioned trabeculae, giving the appearance of a multilocular gland.

5. Epithelial surface with the mouths of the crypts also lined by epithelium of a stratified squamous type.

6. Crypts which appear in various forms, some single slits, some divided in two or three branches, some appearing dilated. Most of them run in an irregular course and reach near the capsule. They do not appear to communicate with one another. The epithelium lining these crypts varies considerably in thickness of its layers.

7. Arteries and veins of variable sizes are seen everywhere in the section, but particularly near the capsule they are most numerous and largest. In three tonsils serially sectioned I found the largest blood vessel (artery) at the junction of the upper two-thirds with the lower one-third of the tonsil and nearer its posterior extremity. In the majority of the tonsils sectioned I found small arterial twigs entering from the mucous membranes of the pillars and plicae, particularly at the lower portion. The largest veins are seen at the lower part of the tonsil.

8. The muscle fibers on the outside of the capsule are striped and are part of the constrictors of the pharynx. The amount of this tissue depends on how cleanly one is able to dissect the tonsil, or how firmly the attachment is to the surrounding muscles. Some muscle fibers are seen to run along in the trabeculae, but are not distinctly striated.

9. I have found in some cases lymphoid tissue outside of the capsule, not near the mucous membrane margin, and this is an interesting finding, for one could only determine how much more of this tissue remains in the fossa by deeper dissection or post-morterm. This lymphoid tissue may be compared to the parathyroid glands, and may take on the function and pathology of the tonsils after they have been removed.

The histologic pathology of these tonsils will be taken up later.

PATHOLOGY.

In this sketch I do not desire to speak very extensively of the general pathology of tonsils, except so far as I found the conditions in cases that came under my personal observation, and this not in great detail. One could easily write a very extensive treatise on the pathology of any one condition of the tonsil, which, of course, is not within the province of this paper.

TONSILS OF A CHRONIC LACUNAR INFLAMMATION.

Macroscopic Examination.—These vary a great deal in size; some are so small as to make it appear impossible that they could cause all the trouble ascribed to them. The exposed portion shows usually a number of dilated mouths of crypts, many times filled with yellowish-white, cheesy masses, the size of millet seeds. They have a very foul odor. The mouth of the crypts situated uppermost is the largest and is known sometimes as the sinus tonsillaris. It harbors the greatest quantity of this material, oftentimes hidden by the margo supratonsillaris. The anterior pillar and plica triangularis may also hide some of the openings of the crypts. These mucous membrane structures, as also the posterior pillar, are thickened in many instances, and irregularly attached to the tonsil. The capsule which has a certain degree of thickness in a majority of tonsils is more firm in cases that give a history of many attacks of acute exacerbations, peritonsillar abscesses, or where previous cauterization or tonsillotomy have been performed. In these cases there are more shreds of muscle and fibrous tissue attached to the capsule. Section through such tonsils reveals dilated crypts filled with cheesy masses, particularly in the upper portions.

Microscopic Examination.—This has already been described in the histologic examination of the tonsil. All I wish to add is that in the inflammatory tissues, round cell infiltration as well as older cells vary according to the period of the attack when the tonsil has been removed. Staining for microorganisms has proven of no value. We could very seldom find any. Examination of the cheesy masses shows a mass of dead epithelial cells, fat, mucus, leptothrix threads, and a number of cocci and bacilli (not tubercular).

Special attention paid to finding tubercular foci proved negative. In about half a dozen tonsils I found areas in

which there were suspicious tubercles, but only one case showed typical giant cells.

HYPERPLASTIC TONSILS.

These occur most frequently in children, associated with adenoids and are usually large and round, with a smooth, mucous membrane surface. The mouths of the crypts are not very large. The surrounding mucous membranes of the pillars, etc., are not markedly adherent, and not much thickened. The capsule is much softer and the retrotonsillar adhesions to it are very few. Section through the tonsil shows the crypts very little dilated and the absence of the cheesy masses is conspicuous.

Microscopic Examination.—Marked increase in the lymphoid tissue, and very little organized inflammatory connective tissue, or round cell infiltration. The capsule appears thinner, as also the blood supply. Barely any muscle fibers attached to capsule, and no muscle tissue within the tonsil, as found in the adult lacunar inflamed tonsil.

HYPERKERATOSIS OF THE TONSIL. (LEPTOTHRIX.)

This condition is usually associated with chronic hyperkeratosis of the Waldeyer's ring of lymphoid tissue, characterized by whitish masses firmly adherent to the mucous surfaces of the tonsil and within the crypts. Very little inflammation accompanies this pathologic change, nor are the tonsils much enlarged. The capsule is not thickened. Microscopic examination shows the keratitic changes of the epithelial and subepithelial structures which show the bushy appearance of the leptothrix buccalis within its meshes. In some areas the tonsil appears as in chronic lacunar tonsillitis.

TUBERCULOSIS.

This was a case of possible primary unilateral tubercular tonsil. It was twice the size of the opposite (large walnut). Firm adhesion of the surrounding mucous membrane. Otherwise had the appearance of the chronic lacunar inflamed tonsil. Macroscopically, the tubercular focus could not be distinguished.

Microscopic Examination.—Usual picture of a chronic

lacunar inflamed tonsil, but many areas of typical tubercular infection, as giant cells and epithelioid cells. Considerable round cell infiltration.

LUETIC TONSIL.

(Removed under a mistaken diagnosis.)

Both tonsils very large; otherwise appearing like chronic lacunar inflamed tonsils. Cross-section showed the abscence of dilated crypts, but a number of grayish-white areas.

Microscopical Examination.—Marked round cell infiltration, with caseous gummi in the center. The arteries appear thickened, but no distinctly obliterated vessels were found.

ACTINOMYCOSIS OF THE TONSIL.

In a case of actinomycosis of the middle ear, which I published in the ANNALS, one tonsil was enlarged, and on removal was found to be firmly adherent to the peritonsillar structures. A number of fistulous tracts could be traced towards the ostium tubae. Several greenish bodies (characteristic of this lesion) were expressed from the tonsil.

Microscopic Examination.—Acute and chronic inflammatory areas all through the tonsil. Mallory-Wright stains demonstrated the actinomyces in the tissues.

ADENOCARCINOMA.

Unilateral.—About three times as large as its opposite (two and one-quarter inches in its greatest diameter). Markedly thickened mucous membrane surrounding the tonsil and firmly adherent to it. No evidence of cheesy masses. The capsule is intimately connected with the retrotonsillar tissue, and cannot be made out as a separate structure.

Microscopic Examination. — Typical adenocarcinomatous structures; however, not penetrating beyond what I take to be the capsule, which is much thickened by the resected retrotonsillar tissue. Very large blood vessels, particularly veins, are present.

SARCOMA.

Unilateral.—About the size of a small apple; smooth, and not much evidence of inflammation. The mucous membrane

is thin, stretched over the tumor. No evidence of any mouths of crypts. No evidence of a capsule. Soft friable tissue in its stead. Large vessels are seen cut across.

Microscopic Examination.—Round cell sarcoma; practically no evidence of true tonsillar structure. The mucous membrane covering the tumor not involved. Large vessels and some distinct endothelially-lined blood lakes. No evidence of a capsule.

ENDOTHELIOMA.

Unilateral.—About the size of a small apple; smooth surface. The crypts of the tonsil are distinct. Over the most prominent part of the tonsil is an area of ulceration. No evidence of a capsule, but in its stead a soft tissue mass is discernible. Large blood vessels are seen cut across in many places. Section through the tumor gives the appearance of a very fleshy mass, soft in character.

Microscopic Examination.—An endothelial growth, principally endovascular. Many blood vessels seem to be filled out with endothelial cells. Very little connective tissue or true tonsillar structures present, except the mucous membrane or exposed portions. No evidence of the capsule.

The history and final outcome of these rarer pathologic cases are of great interest, but not within the limits of this paper.

SURGICAL TREATMENT.

I consider three principal procedures in the management of the tonsils, namely, (1) tonsillotomy by guillotine; (2) partial tonsillectomy; (3) radical enucleation.

The distinct indication for the particular procedure is to be found in the history and pathologic condition present.

For the first procedure, namely, tonsillotomy by guillotine, I can see but one class of cases that should be thus operated upon, and those are the hyperplastic tonsils. Even many of those do some time or another return with trouble in the stump, perhaps several years later. I shall not spend any time on the technic, as it is too well-known to every general practitioner. All I wish to say is that I perform it less and less all the time. A snare will do much more thorough work without any other additional operative interference.

Partial tonsillectomy, which has still its many followers,

is an operation that will be followed by excellent results and until about four years ago I performed this operation in the majority of my cases. In a goodly number of cases, particularly in children under general anesthesia, I still do this operation, providing there is not a special indication to be more radical, as, for instance, some general systemic infection or many attacks of tonsillitis. The technic in these cases is simply to separate either bluntly or sharply the adherent pillars and snare the tonsil off, or remove by scissors, punch forceps, or even tonsillotome. There is no distinct attempt made to remove the capsule; in fact, the attempt is made not to remove it, and as little of the surrounding mucous membrane of the tonsil as possible. The result from such a procedure is that there is less reaction and subsequent soreness, particularly in swallowing. There is also much less contraction secondary to the healing of the tonsillar wound There is much more bleeding in this procedure than in the radical operation.

One thing is a fact, we do not know positively that this operation will cure the patient as a radical operation will.

RADICAL ENUCLEATION OPERATION.

A confrére of mine, who is evidently not in favor of this procedure, once put the question to me like this: "Why do you wish to do such an operation? The tonsil is not a malignant growth." It is true that the majority of the diseased tonsils removed are only inflammatorily diseased; nevertheless, it is a structure which, when it is thus affected, will cause much trouble from chronic septic absorption, such as chronic endo- and myocarditis secondary to what are known as rheumatic affections; so I consider these tonsils malignant, in that sense of the word, and they should be removed radically, because when done otherwise the trouble is not cured. Who has not seen cases come back after a tonsil operation, with repeated attacks, simply because stumps were left in, when they should have been cured? I have yet to see one case where the tonsil was removed with capsule intact that returned with complaint of the original trouble.

Before describing the steps of the radical tonsil operation that I pursue, permit me to illustrate the simple necessary instruments.

In Children.—In the majority of cases I employ a general anesthetic—ether. In the past year I have used the nitrous oxid-oxygen continuous anesthetic, which works very satisfactorily. The position of the patient is in the recumbent one, and on the side, with the head close to the edge of the table.

Illumination by an electric head lamp.

Assistants: Well-trained, especially in the swabbing of blood and depressing the tongue.

In a small number of cases in very young children, from four to eight years of age, I have performed the radical tonsil operation under local anesthesia, as in adults, but on general principles I would not advise it.

STEPS OF THE OPERATION.

The steps of the operation are so similar to those employed under local infiltration anesthesia that I will just mention the exceptional points.

1. Injections of adrenalin solution 1/5000, about 20 minims each, into anterior and posterior pillars to control the bleeding during operation.

2. The use of the finger for blunt dissection, after the initial incisions are made, produces a rapid and thorough enucleation of the essential portions of the tonsil.

3. The completion of the operation in the removal of the lowest portion of the tonsil is performed with the aid of the snare.

4. Spurters are grasped with the angiotribe and free oozing is controlled by a firm sponge being pressed into the cavity and held by an artery forceps, which is used as sponge holders during the operation.

5. Prevent the child from falling asleep too soundly after operation in order to guard against its swallowing too much blood. Allow the closed mouth-gag to remain in the mouth for about half an hour, so that if there should be much bleeding one can easily reopen the mouth and stop it.

In Older Children and Adults.—The technic is as follows:

1. Seated in an upright position, with head supported by an assistant.

2. Swab the general pharyngeal surfaces with a 20 per cent cocain solution.

3. Inject by means of tonsil syringe (Fig. 1) a mixture of adrenalin, 1-1000, and cocain hydrochlorate, 2 per cent, equal parts, into the anterior and posterior pillar, supratonsillar and infratonsillar areas. These injections are made by piercing the mucous membrane with the needle, and raising a bleb, as by a Schleich injection. Each bleb holds about five minims. Four such blebs usually suffice to anesthetize the area completely. One side is injected at a time; that is, the opposite side is not injected until the first side is enucleated.

4. Depress the tongue and grasp with the volsellum forceps the upper and lower portions of the tonsil, taking a good firm bite, and locking the forceps. Remove the tongue depressor.

5. Draw the tonsil toward the uvula by means of the volsellum forceps, until it appears quite prominently behind the margo supratonsillaris and anterior pillar.

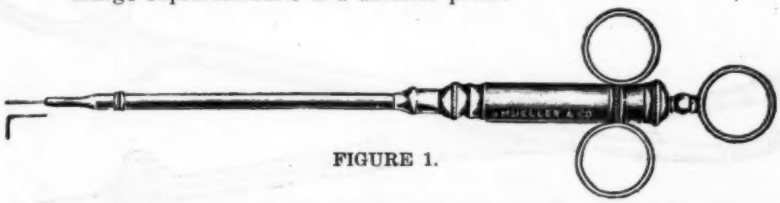


FIGURE 1.

FIGURE 2.

6. With the tonsil knife (very sharp, Fig. 2) make an inverted U-shaped incison through the mucous membrane of the margo supratonsillaris, anterior pillar and through the plica. This original incision must be performed with the greatest care not to penetrate the capsule. Carefully cut the adherent fibers close to the capsule, which appears whitish. Using the opposite end of the knife, I bluntly peel off some of the supratonsillar adhesions.

7. Release the volsellum forceps; give patient a little rest, and if there is some oozing, give patient a solution of peroxid of hydrogen to gargle.

8. Reapply the volsellum forceps, except this time the upper prong of the forceps grasps the already dissected head

of the tonsil. By drawing the tonsil now down and in, we observe some large fibers of retrotonsillar areolar tissue, and some muscle fibers. Before cutting these I apply the

9. Angiotribe (Fig. 3) to these fibers, crush them, take off the instrument, and cut the fibers close to the capsule. In this way one will observe very little bleeding.

10. The mucous membrane of the plica triangularis is now severed from the anterior pillar, and the tonsil further dissected.

11. Change hands (you should be ambidextrous). With volsellum the tonsil is now pushed back into its bed and the posterior pillar is severed from the tonsil. This procedure

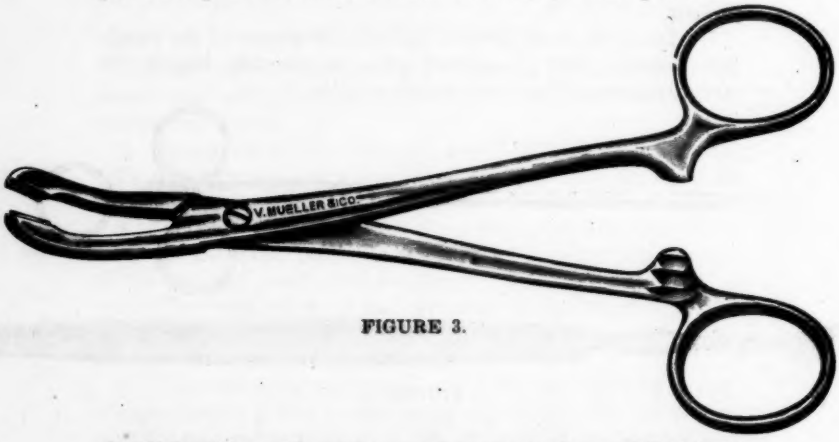


FIGURE 3.

should be done with great care, because undue multilation of this structure will cause secondary contractures of a very disagreeable type.

12. The tonsil is now free on all its sides, except at the bottom, which is the most firmly adherent, and one that disturbs the patient the most when manipulating. It causes most of them to gag. The traction with the volsellum is now made upwards and inwards. Before each incision the angiotribe is put on to crush the vessels, and the direction of the knife is towards the base of the tongue, as though one were going to cut it, which, however, never occurs. Thus the operation is completed and the cavity appears as described under the head of anatomy in this paper. Should there be considerable ooz-

ing or even free bleeding, then take a sponge soaked in peroxid into angiotribe, and press into the cavity created by the dissection, and press it firmly against it. This will result in a great deal of foam, and the patient must be cautioned not to inspire a quantity of this material, because it may cause some embarrassment in breathing. After a few moments the sponge is removed and the surface can be inspected for any distinct spurter. If such be present, then it can easily be grasped with the angiotribe and closed by crushing. No attention need be paid to the venous oozing; it always stops very soon after operation. The injection of the opposite tonsil is now performed, and the same steps are followed. The second tonsil is always more difficult to remove, because the patient is irritated by the oozing from the other tonsil cavity, and besides in many instances the patient feels the effect of the operation. Not that he suffered any particular pain, but a discomfort from the pulling by the volsellum forceps.

I usually begin with the patient's left tonsil, because it is easier of removal, gives one the practice, and the patient the confidence.

Not all cases go as smoothly as described, because several conditions may interfere. In the first place, a very irritable individual who cannot stand anything on the tongue or in the throat, as even the sensation of the cocain, will gag and sputter, making the operation very difficult. Some nervous individuals faint at almost any stage of the operative procedure from sheer fright or shock from pulling on the forceps, or other causes. It therefore becomes necessary to terminate the operation more rapidly. In such cases, usually, however, one can dissect the head of the tonsil. I make use of the snare and eventually go in after the stump subsequently, that is, a few moments later.

After-treatment.—The patient is placed on the cart and not allowed to walk; placed in bed, and not allowed to speak; to rasp the throat and spit out only when absolutely necessary, for the next half hour. A glass of peroxid of hydrogen is at hand, and he is told to use it if the throat bleeds, if patient has no special nurse. Since this is a hospital operation, the chances of hemorrhage with such a mode of treatment are very slight.

The next day or two the patient is kept on liquid diet; in fact, he does not desire to swallow very much.

Cleansing solutions of 1-1000 permanganate of potash are used, and local applications of tincture of iodin to the tonsil wound. This constitutes the after-treatment.

This large cavity created by the radical operation begins to fill in very rapidly, and on the third day it is practically filled with an organized blood clot and granulations. In about two weeks after operation one would scarcely believe that the entire tonsil had been removed, and many cases show a mass between the pillars having the appearance of a tonsil stump.

I have removed some of these tonsil stumps and found no lymphoid tissue microscopically; only inflammatory structure.

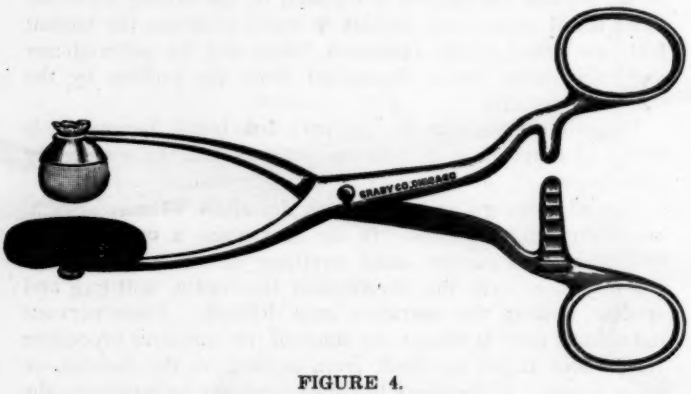
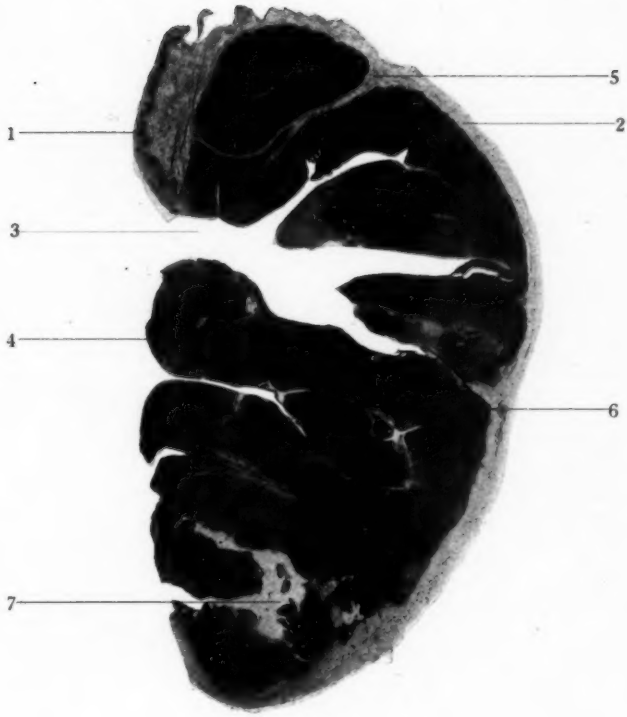


FIGURE 4.

In quite a few cases, especially where the surrounding tissues were mutilated, I have seen some had contractures and scars, although very little complaint was made of them by the patient. Such complaints as a burning sensation in the throat, easily tiring when speaking, some difficulty in swallowing, belong to the greatest minority.

Should one have such a disagreeable complication as primary or secondary hemorrhage that could not be stopped by grasping the spurter or by local applications of the various styptics and cauteries, I would recommend, instead of the use of the Mikulicz clamp, what has proven of service in a case of a colleague of mine, namely the author's tonsil hemostat, as



Colored Photograph—Lumiere's process—of a Section of a Tonsil, radically removed on account of Chronic Lacunar Disease

1. Margo supratonsillaris
2. Fibrous capsule of tonsil
3. Dilated tonsillar crypt
4. Epithelial surface
5. Trabeculae or septa
6. Lymphoid tissue
7. Degenerated and mechanically lacerated crypt

shown in Fig. 4. Of course, whenever a spurter can be grasped, it had better be done, in preference to any other method.

In all my experience I have had but two severe tonsil hemorrhages after the removal of chronically inflamed tonsils, and both recovered. That does not mean that I have not had patients who bled quite a good deal.

IV.

OUR EXPERIENCES WITH THE KILLIAN FRONTAL-SINUS OPERATION.*

By Dr. von Eicken,

Freiburg i. Breisgau.

Translated by Clarence Loeb, A. M., M. D.,

St. Louis.

Gentlemen: Since the Krauss-Killian paper on Killian's radical operation on the frontal sinus in 1903, an extensive literature has appeared dealing with this method. Killian himself, very thoroughly explained his method at Heidelberg in 1904, gave some modifications of the technic, and above all defined its indications. Since then, much has ben written pro and con, and this contest has not yet been settled. It is therefore in order to relate the results collected in our clinic during the last six years. The shortness of the time allowed to me forbids my going thoroughly into all the points coming into consideration, but these will be given in a larger article.

I am able to report 100 cases observed from 1902 to the end of 1907. Of these, 58 were men and 42 were women. Many of you will be astonished at this large number, but you will understand it when I analyze it a little more. Forty-two of these cases come from the private practice of my chief, and of these, only 16 are from Freiburg and its vicinity, while 27 were sent to him for operation from a considerable distance. In the cases belonging to the poorer classes—the patients of the third class—it should also be noted that 13 of them were sent to us.

A bilateral operation was necessary 20 times; of these, 7 were performed at the same time, and 13 were operated on the two sides at different times. By far the greater

*Read before the International Laryngo-Rhinological Congress at Vienna, 1908.

number of cases were operated by Killian himself, 23 by me, and 2 by the other assistants in the clinic.

In 20 cases, an operation had been performed by some one else, without curing the frontal sinus. Six of these had cicatricized wounds and 14 had fistulae. In these the radical operation seemed absolutely indicated. The diagnoses was based, in the other cases, on the endonasal findings and the results of lavage of the frontal sinus.

In 4 cases, the fear of intracranial complications was the indication for the operation. These were cases that had formerly suffered from accessory sinus affection and then had acute attacks with severe pain, while lavage of the frontal sinus gave foul-smelling pus. Only in one case, where there previously had been no frontal sinus involvement, where removal of the anterior end of the middle turbinate in no way influenced the terrible pain, and where even morphin gave scarcely any relief, were we compelled to make a radical operation 14 days after the beginning of the acute trouble. I would add that to-day, when we have in Bruening's headlight-bath a wonderful aid in combating pain in acute cases, even such a case could probably have been cured without operation. Where scarlet fever or trauma has caused the disease, we advise our patients against endonasal operations and at once perform the radical operation. The same is true in cases of extensive polypus formation complicated by asthma, where the endonasal treatment previously carried out by other physicians was followed always by only temporary amelioration. The urgent desire of the patient to be freed as soon as possible from the suffering he has undergone for years is a very good reason for the radical operation, if the results of radiography and transillumination make the possibility of endonasal cure of the affection very problematic. We advised the radical operation in a case where neurasthenia had followed numerous unsuccessful endonasal operations. In all other cases, more than 60, there was a chronic affection where the lack of success from endonasal operations was the reason for the radical. In a large number of these patients, numberless operations—without exaggeration—had been performed on the nose without obtaining the desired cure.

As to the technic of the operation, some improvements

have been made lately. In the first place we now make the incision through the soft part the same throughout its entire length, check the hemorrhage, and before opening frontal cavity, detach the periosteum from the lateral nasal wall and the orbit, tampon this with gauze, and only then proceed to open the sinus over the nasal portion of the supraorbital ridge, when we can count with certainty upon finding a cavity. If the relationships are not so distinct, we resect the processus frontalis of the upper maxilla, the upper portion of the lachrymal bone, a part of the lamina papyracea, the anterior ethmoidal cell, and the floor of the frontal sinus, and thus open the frontal sinus beneath the nasal portion of the supraorbital ridge, so that we eventually lay bare the mucosa which extends upward into the frontal bone, above the supraorbital ridge.

We cannot approve of the numerous, different propositions to partially or totally preserve the anterior frontal wall. The danger of overlooking a portion of the frontal sinus because of the smallness of the opening, and thus allowing diseased mucosa to remain, is much too great. This has been clearly proved by the numerous cases of fistulae coming to us from other places for treatment. If we are to attack the frontal sinus from without, the operation must be so performed that all recesses can be clearly seen. In two cases operated by me years ago, when we could not diagnosticate the extent of the sinus by means of the Roentgen picture, I saw that overlooking a recess and allowing the mucous membrane to remain, even in a circumscribed place, could cause a relapse, even after years of apparent cure. It is of great importance to thoroughly exenterate the orbital recesses, which are found so frequently, as well as the anterior ethmoid cell, which developes towards the root of the nose. When all the recesses and spaces in the frontal sinus have been sought out and their mucosa radically removed, there comes the second postulate, viz., that a broad exit from the operated cavity into the nose be made, which demands the resection of the processus frontalis maxillae superioris. The removal of this bone, which is often very thick, never causes such technical difficulties as to cause one to refrain therefrom. The hemorrhage from the nasal mucosa can always be controlled by tamponing the back of the nose from

the interior of the nose. It is important in obtaining free outflow of the secretion that the nasal septum does not curve too much toward the operated side, otherwise there may be synechial formation and retarded cure. When it is possible, we should try to correct high degrees of septal deviation some time before the radical operation.

The retaining of an arch was only partially possible in several fistulae cases, on account of preceding operations, likewise in 3 cases of caries of the anterior wall and region of the ridge itself. In the great majority of cases, however, an arch could be formed, but I should state that in 3 cases with very thin bone, it collapsed either during the operation, or later on account of a trauma. We have entirely given up the formation of a mucous flap. The sizes of the sinuses were very different. Very large cavities were found 36 times, medium sized 42 times, small 28 times, and of the latter, 4 were so small that their contents could be removed without opening over the ridge. Twice, an actual frontal sinus was absent. Extensive subdivisions of the sinus were frequently found, and once the interesting observation was made that two completely separated cavities had been formed, the medial of which was diseased while the lateral was healthy. As to the contents of the cavities, a more or less swollen mucosa was found in most cases—7 times distinct polypi formation in the frontal sinus itself—furthermore, more or less secretion, sometimes mucous, sometimes muco-purulent, sometimes purely purulent, and not rarely the pus had a very foul odor. Acute inflammatory changes shown by strong hyperemia or greyish-green discoloration of the mucosa, were seen five times. In the cases with fistulae formation, we frequently saw distinct granulations in addition to the hypertropic mucosa. This was also found in 3 cases with caries, and in these cases both anterior and posterior walls were carious. The dura, covered with granulations, lay bare.

If we could not decide before the operation whether a severe disease of the ethmoid was complicated by frontal sinusitis, and consequently exploratively laid bare the latter's mucosa, we found six times no definite disease, and three times confined ourselves to making a large hole in the floor of the frontal sinus, after exenteration of the ethmoid. Yet we were forced to regret this procedure, as the frontal

sinus invariably became secondarily involved, and later had to be radically operated. Apparently the removal of the floor of the frontal sinus injured the very important blood vessels, which are developed from those of the nasal mucosa, in such a way that a locus minoris resistentiae for a new infection was formed as a result of a deficient blood supply. In the other three cases, we decided to remove the normal mucosa at once, since these cavities were not very large. In the operations on one side, we sometimes accidentally perforated the septum interfrontale. If the mucosa appeared healthy, we refrained from operating on the other cavity. Twice, however, the typical operation was done on the other side also; once, because there was a foul discharge, and the other time because we wished to obtain a better drainage for a diseased sinus that extended far towards the healthy side. If the sinus opened through the septum was found diseased, we frequently removed only its anterior wall, without performing the radical operation on the other side. In these cases, we could not expect a cure, and were actually compelled later to perform the typical operation on the other side.

Unilateral, isolated frontal sinusitis was not once observed. The anterior ethmoid cells were always involved, and in the majority of cases the antrum also. Many patients came to us with tubes in their alveolae, through which for a long time they had been accustomd to wash out their antra. Several antra were bored into or radically operated by us before the frontal sinus operation, and for this we have been using for the last three years only local anesthesia.

Thirteen times, radical operation on the antra immediately preceded that on the frontal sinus. In twenty cases we were later forced to operate radically on the antrum after the frontal sinus had healed, and I would like to state here that whenever we found pus during the after-treatment of our cases, the antrum was almost invariably the source. Doubtless we have ascribed to the regular lavage of the antrum a greater curative power than it actually possesses, and it is my advice to operate on the diseased antrum either before or simultaneously with the frontal

sinus, or at least to make a large opening into the lower nasal meatus.

With the above sentence we touch upon the chapter of after-treatment of operated frontal sinuses. Permit me to say something about the care of the wound itself. With the exception of 17 cases, we closed the wound primarily, yet not less than 19 cases showed greater or less disturbance in wound healing, which frequently appeared as stitch abscess, but sometimes as retention symptoms, and compelled us to reopen the wound to a greater or less extent. Three times there was an erysipelas of the wound. The secondary suturing, which usually took place two to five days after the operation, was sometimes followed by inflammatory symptoms, which caused us to reopen the wound and tampon. Upon reviewing the material, I come to the conclusion that we undoubtedly used the primary closure too frequently. This ought to be done only when drainage is very good, symptoms of acute inflammation of the mucosa are entirely wanting, and the pus has no foul odor. In all cases where we know from earlier operations that there was a tendency to disturbances in the course of the healing, it is much better to suture secondarily. Of the other, transitory inflammations which followed our operations, I would mention that angina follicularis frequently appeared; once there was a tonsillar abscess; twice, otitis media, which healed after paracentesis; once, a pneumonia of the right apex which resorbed completely.

It is very important to remove carefully and completely all strips of gauze, drains and tampons which have been introduced into the nose. If one is forgotten, the course of healing is disturbed, for which we were to blame three times. To avoid such an oversight as much as possible, we have for a long time used only one gauze drain, whose outer end was knotted. Only when this knot had been drawn out of the nose could we be sure that no gauze had become detached and left in the wound.

A hemorrhage into the orbital tissues happened to us once, but was resorbed without any bad symptoms. We had, also, two hemorrhages into frontal sinuses upon which we had operated. Both times, the clot was discharged in a short time through the nose, and the wound did not break open. A severe hemorrhage from the an-

terior ethmoidal vessels compelled us once to reopen the field of operation and ligate the vessels. Rarely did diplopia follow the operation. It usually disappeared in a few days. It was complained of for longer than one month in only five cases, but it always sooner or later disappeared. One case, however, upon which I operated ten months ago, still suffers from double vision, which, however, does not disturb the patient very much. Whenever a diplopia lasts for some time, there is always a cavity whose extent upward was very slight, and which, therefore, extended so much deeper into the orbital roof and outward. The postulate, to remove all diseased mucosa, compelled us to detach the periosteum of the arcus supraorbitalis more externally than usually in order to obtain sufficient access to the lateral recesses. Wherever such a detachment can be avoided, one should not expose the patient to the danger of a long continued diplopia, even though the operation thereby becomes more difficult and tedious.

Of the other ocular disturbances, we once saw a very transitory paralysis of the levator palpebrae superioris, probably caused by pressure of the drain, and a stubborn entropium spasticum in a man who since childhood had been blind on the operated side from old iridocyclitis and amotio retinae. We were compelled in the latter cases to put a ligature through the lower lid, and thereby draw the lid downward for several days.

Anesthesias and paresthesias, caused by severing the nervus supraorbitalis, were frequently complained of by women, but these symptoms sooner or later disappeared. We were especially careful in these cases where the frontal sinus suppuration was apparently complicated before the operation by neuralgia of the supraorbital nerve. Ten times, during the radical operation, we removed the nervus supraorbitalis by slowly pulling it out. We have learned thereby to remove the whole nerve, which, as it leaves the foramen supraorbitale divides into two branches; one of these ascends perpendicularly, and the other runs outward parallel to the arcus supraorbitalis. This latter is very easily overlooked. Twice it had to be removed secondarily. The nervus supratrochlearis, a portion of the nervus frontalis, compelled us three times to make a secondary operation, on account of neuralgia.

The most frequent cause for secondary complaints was the antrum. As I have already stated, twenty times after the frontal operation, an extensive one—usually the Luc-Carlwell's—was required for the antrum. More rarely, it was necessary later to remove nasal polypi, usually in those cases where the ethmoid had been insufficiently exenterated. Only in two cases could we give no exact reason for the reappearance of polypi. In both cases, numerous operations had been made within the nose before the radical operation, resulting in atypical changes in the nasal mucosa such as synechiae and cysts. In some cases the sphenoid had to be opened secondarily.

If we would estimate the value of an operative procedure, we should know above all to what extent the life of the patient is threatened. Formerly, we did not think that Killian's frontal sinus operation, when the proper technic was observed, had any appreciable danger, and we were confirmed in this belief by a review of the 80 cases published by Krauss-Killian, which healed normally. Unfortunately, we have discovered that the otherwise beautiful method is not entirely without danger. We have seen two patients die, soon after the operation, from meningitis, and one, after suffering for a long time, with osteomyelitis of the cranial bone die of subsequent frontal and temporal lobe abscesses. It is a question whether we are to blame the operation for these three cases, and whether similar conditions can be prevented. There were no mistakes in the operative technic. Perhaps we were wrong to suture the wound primarily in the patient who later died of osteomyelitis. The inflammatory process in this case started from the lateral nasal wall and progressed in spite of repeated extensive operations. Both of the cases which died of meningitis possessed on the operated side suppurating antra, which in one case was easily accessible from the middle meatus, and in the other from the alveolar process. In the first case, the infection began at the margin of the remaining portion of the middle turbinate, apparently from the tampon impregnated with antral pus. It ascended through the lymph channels which surround the olfactory fibres, through the lamina cribosa to the bulbus olfactorius and the pia, and rapidly caused a meningitis. In the other cases the patient, in addition to the diseased antrum, had

a sphenoid sinus filled with thick mucous exudate. This was not opened at the frontal sinus operation, since the posterior ethmoid cells were entirely normal. In the most posterior angle of the cavity, some drops of pus were found, and from here we could follow the path of the pus from the mucosa, along the hypophysis to the dura of the base of the brain through the intact sella turcica.

Since this last death, we have had 22 cases, which healed normally.

Ever since, we have made it a rule to operate on antral suppuration either before, or at the same time as the frontal operation. In every case, we try beforehand to diagnose the sphenoid disease, so that we will not neglect its opening and exenteration, even when the posterior ethmoid cells are healthy. Primary suturing is confined to chronic cases with mucous and mildly mucopurulent exudate, and in the other cases suture on the third or fourth day. By taking pains, this secondary suturing gives good results. Thus, we trust to have no other osteomyelitis case.

To test our results, we have made extensive re-examinations. We were able to examine 78 of our old patients, and from 14 we received complete written communications. One case, which will be well shortly, is still under treatment. We have lost track of four cases.

Before I communicate our results, I will explain what I mean when I call a patient cured. There must be no more pain, suppuration or polypi formation. Such an ideal result was obtained in 60 patients; among them are all cases with earlier fistula formation. From the written communications, we may conclude that 9 other patients were completely cured. A distinct improvement was obtained in 16 cases, and in these the frontal sinuses were likewise completely healed. There were, however, other sinuses with greater or less discharge. This came 6 times from non-operated antrum, once from the antrum and sphenoid, once each from the ethmoid and sphenoid alone. In the other 7 cases, two required polypi removal; in one there remained a slight secretion with tendency towards formation of crusts. In two neurasthenic patients, painful sensations persisted, for which no cause could be found. One patient complained of severe pain when she had catarrh, and in the seventh case, without polypi or secretion from

the nose, there reappeared asthmatic attacks, however much less severe and rarer than in the many years before the radical operation. That the patient was in general much better, is attested by the fact that she took on several pounds in weight. One case of ozena remained uncured, where by operating radically all the cavities on one side, we attempted to influence the disease. Repeated abscesses of the operated side was present once, but for this the diseased but not operated other side was responsible. When the patient came to us, she had had no new abscess for six months, consequently was not ready for another operation, which would have explained the abscess formation. Furthermore, 5 cases remained uncured, from whom we received written communications. In one man, there was malnutrition on account of repeated operations, also, perhaps, on account of treatment with Roentgen rays; he still had an open wound in the forehead. In two cases there was an ethmoid suppuration still present, and in the last there was neurasthenia and a chronic nephritis as the cause of the present trouble. There were, therefore, 3 fatal, 7 still uncured, 16 distinctly improved and 69 cured cases. I think that these are results such as no other method before Killian's has shown, especially when we remember that several very severe cases were among our material, which gave our method a very severe test.

The results obtained encourage us to continue in the way we have started. The few bad results which befell us cannot cause us to discard it. We have tried to learn from them and hope to be able to avoid them hereafter.

V.

EXPERIENCES IN THE ENDONASAL RADICAL OPERATION UPON THE SPHENOID CAVITY AND THE POSTERIOR ETHMOID LABYRINTH.

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Vienna.

Translated By Julius Rotter, M. D.,

St. Louis.

I take advantage of the great opportunity offered by this celebrated congress, devoted to the progress of laryngology, to present the rhinologic theme in question in a few words, and to touch upon the amazing progress in the diagnosis and treatment of the diseases of the sphenoid cavity. The pessimistic aspect of earlier days and the words used to express the same, relative to the endonasal inaccessibility of the sphenoid cavity, are well known to all of us, namely, that this route would never open to satisfy our curiosity. That this is not true is evident; that furthermore the sphenoid cavity will in the course of time become most accessible to endonasal treatment is an ironically colored answer to the pessimistic prediction formerly expressed. In no other sinus is it possible by widening the endonasal opening to inspect all the walls of the cavity with detailed precision, as is the case with the sphenoid cavity. The sphenoid cavity lies in the sagittal direction and, therefore, directly in our view by rhinoscopic examination, while all the other accessory cavities depart more or less from the sagittal direction, on account of which the accurate inspection often occasions unsurmountable difficulties. In order to approach my particular theme more quickly, you will permit me to omit the individual steps in the evolution of the diagnosis of the affections of the sphenoid cavity. I may now (in this circle of professional men, thoroughly familiar with the literature) begin at once at the point, which is shown by my article published in the *Archiv. fuer Laryngologie*. I have in the above-mentioned publication called attention for the first time to the fact that the anterior wall of the sphenoid cavity is under ordinary circumstances too

narrow to permit an opening large enough for good drainage. If, besides, we consider the well-known tendency of such openings towards stenosis, then it will be admitted that a sufficiently large and permanent opening can seldom be made by means of the endonasal method. On account of the anatomic relations which exist between the anterior wall of the sphenoid cavity and the posterior ethmoid labyrinth, I came to the conclusion that the anterior wall of the sphenoid cavity is accessible by the endonasal route only after the removal of the posterior ethmoid labyrinth to a large extent. Upon frontal section these relations become immediately clear. The anterior wall of the sphenoid cavity consists, as is known, of the inner narrow part, the pars nasalis, and of the outer wider part, the pars ethmoidalis. The pars nasalis is, as a rule, 2-3 mm. in diameter, so that an opening in this area can only amount to a few mm., and, therefore, is not at all sufficient for permanent drainage. If, on the other hand, the posterior ethmoid cell is removed, then the entire width of the anterior sphenoid cavity wall remains free for establishment of an artificial opening, which is not hard to do with the instruments which I have devised. Experience shows that while in the neighborhood of the pars nasalis the surrounding bony wall of the ostium sphenoidale offers very much resistance, the pars ethmoidalis of the anterior sphenoid cavity wall, as a rule, is very thin and therefore is easily removable. Only after removal of the largest part of the anterior wall of the sphenoid cavity is it possible to maintain permanently a large opening into the sphenoid cavity, and this only when the opening made can be controlled until complete cicatrization of the wound margins. It is remarkable, but as large experience shows, without a doubt, that, just after removal of the largest part of the anterior wall of the sphenoid cavity the resulting opening may in a few weeks entirely granulate over, if the edges are not thoroughly cicatrized by cauterization of the granulations. Abundant growth of granulations, resulting almost everywhere from injury of the bony wall, cause oozing of marrow from the spongy interspaces of the bone after inflammatory reaction. The cauterization of the granulating edges is done once a week, until complete cicatrization is accomplished; only then is it certain that the opening established will retain its original size. In this manner we also treat the affections of the sphenoid cavity, at the ambulatorium, where without further measures one may inspect the inner lining of

a large part of the sphenoid cavity through the large openings. The above-mentioned cases have remained cured for years, and only during an acute attack of catarrh is the inside of the sphenoid cavity as well as the remainder of the nasal mucous membrane affected. This secretion loosens up as the cold passes away without any further assistance, this being proof that the large drainage opening always guarantees the spontaneous cure and prevents the permanency of the inflammation. I have up to date over 18 cases of permanent cure, and with exception of two post-operative hemorrhages nothing ever happened to excite any apprehension. I have never considered the question of removing the mucous membrane of the sphenoid cavity, and have guarded against such action, because I am of a different opinion in regard to that from many prominent colleagues. I determined only in few cases to remove the largest part of the inner lining of the sphenoid cavity, because I have found that portions of the mucous membrane, which are greatly altered, retrograde spontaneously after a wide opening of the sphenoid cavity. It is an undenied fact, to which I called attention four years ago in the publication of this radical operation in the *Archiv. fuer Laryngologie,* that a very much swollen and edematous mucous membrane does not necessarily point to an irreparable disturbance of the same; much more this change not uncommonly has the appearance of an acute and subacute inflammation, which under favorable conditions returns to normal. I was able to see very plainly, after broadening the opening of the anterior wall of the sphenoid cavity, that such a swelling of the mucous membrane may be of a transient nature. After enlarging the opening of the sphenoid cavity and cleansing the same we sometimes see circumscribed thickenings of the mucous membrane. A few days later, however, the whole mucous membrane of the sphenoid cavity may be changed into a very thickened edematous cushion, which nearly fills the entire cavity. This high grade, diffuse swelling of the inside of the sphenoid cavity coming on in a few days is the result of the acute, severe reaction of the cavity lining, together with the progressing operative interference. This is proved by the fact that in a few days the entire condition spontaneously resolves. We also notice after post-operative opening of the sphenoid cavity, that a part of the altered mucous membrane retrogrades after a few weeks, so that it is almost never neces-

sary to remove the entire inner lining of the sphenoid cavity, but it is sufficient to remove the circumscribed parts. Before curetting the inside of the sphenoid cavity we should, in view of the common occurrence of defective places in the outer upper wall of the sphenoid cavity, generally examine the same. The question now before us is to decide the indication for the external against the endonasal method of radical operation. According to my contention, the endonasal method is suitable in all cases. The only possible obstacle, a highly-situated deviation of the nasal septum, can be removed by subperichondrial resection. The external method, according to my view, is of use only in cases of combined empyema, in which some of the other diseased adjoining cavities necessitate a radical operation. In connection with such a radical operation, the operation upon the sphenoid cavity can also be done. It is possible, in connection with the Killian radical operation of the frontal sinuses, to evacuate the ethmoid and sphenoid cells, and in connection with the radical operation on the maxillary sinus the sphenoid cavity may be operated upon after the method of Jansen.

VI.

SOME INTERESTING MASTOID CASES WHICH HAVE COME UNDER MY OBSERVATION DURING THE PAST YEAR.

By Frank Allport, M. D.,

Chicago, Ill.

A recitation of cases is, of course, not always interesting to the reader, and yet I have had under my observation during the past year or so some cases that were of sufficient interest to me to make me feel that they might also be of interest to my colleagues. I have, therefore, in the following article endeavored to give the history of these cases in as brief a manner as possible, dwelling simply upon the salient and interesting features of each case.

Case I.—V. C., age 22 years, was seen July 31st, 1908. History: June 19, 1908, he was stabbed by a man with a red-hot iron. Iron pentrated head at apex of left mastoid, causing instant left-sided facial paralysis.

Remarks.—This case is merely mentioned on account of its rarity. I have never seen a similar case, nor have I read of one in aural literature. The iron, of course, injured the nerve shortly after its exit from the stylomastoid foramen. I have not seen the case since the first visit.

Case II.—J. O., age 32 years. This man was operated by me in 1905 for an acute mastoid abscess and was dismissed in about one month. He returned in 1908 with a red swelling over the antrum, which was opened and pus evacuated. Granulations and necrosis were found in the antrum, which were scraped away as thoroughly as possible in the office, without the performance of a major operation. The cavity was cleansed and packed daily and aromatic sulphuric acid occasionally applied to the bone. The discharge was staphylococcic in character and an auto-vaccine was prepared and twice used. In about two weeks after using the vaccine he was apparently

cured and sent home. I heard from him about six months later and he was well.

Remarks.—This case is reported because, I presume, in my original operation I was not as thorough as I should have been in cleansing the antrum, and because I wish to give all due credit to the auto-vaccine. It seems strange, however, that no antrum outbreak should have occurred for three years if the fault was mine in not sufficiently curetting the antrum in 1905. This brings up the possibility mentioned by some authors of the occurrence of post-operative necrosis. It seems strange also that the outbreak was confined to the antrum, to the entire exclusion of the tympanic cavity. Whether the vaccine had anything to do with the cure must, of course, be conjectured, as other treatment was used at the same time. Judging, however, from past experience and observations of other similar cases, I believe it had.

CASE III.—Miss A. I., age 35. I operated this woman in May, 1908, for an acute mastoid abscess. She left the hospital in about one month and became an office patient. The discharge from her ear ceased in a few days. The parts healed thoroughly, with the exception of a fistulous canal leading from the skin to the antrum. This canal refused to heal, indicating, I presume, as in case two, that I had not thoroughly removed all of the antrum necrosis at the operation. This fistula was treated for weeks and still stubbornly refused to heal. Finally, the drumhead broke down again and a profuse middle-ear discharge occurred. I had about made up my mind to reoperate this case and perform a radical mastoid operation, but concluded to first try auto-vaccination. The discharge proved to be staphylococcic in character and the auto-vaccine was prepared and used twice. Within three days the tympanic discharge ceased and in about two weeks the fistula entirely closed. Seven months have now elapsed since this occurred and the patient is still apparently perfectly well.

Remarks.—I mention this case because I wish to distinctly give credit to the auto-vaccine for having cured the case which had been previously treated in every possible manner without success. The cure occurred too suddenly to have been produced by anything but the vaccine.

CASE IV.—D. F., age 4. I operated this case for acute mastoid abscess in June, 1906, and the patient was discharged as cured in about six weeks. I saw him again in June, 1908, at

which visit he had a red, fluctuating swelling over the antrum, which was opened and disclosed a fistulous canal leading into the antrum. Pus was evacuated, the canal and bone curetted of granulations and necrosis, as well as could be done at the office. This case was treated exactly like case two and case three, without result, for several weeks, at the end of which time a staphylococcic autovaccine was prepared and used twice with a resulting cure in about two weeks, which has continued up to the present time.

Remarks.—I have, I think, reason to believe that the vaccine cured this case. At all events, I had no success in treating it by other means. I hope these three cases will not give the reader the impression that such cases are frequent with me and that I do not thoroughly remove the necrosis from the antrum. I give them, however, just as they occurred, because it shows the possibility of such results, and also because I desire to give the autovaccine its just credit, whatever that may be.

CASE V.—Miss A. C., age 45, consulted me August 3rd, 1908. She is a neurotic. About two years ago she contracted an attack of influenza, followed by excessive pain in the right ear and mastoid. No aural discharge. Nose and accessory sinuses normal. Mastoid very painful to the touch. Her family physician, who is an exceptionally skillful practitioner, administered most if not all forms of treatment for neurasthenia, neuralgia, etc. The right drumhead was inflamed, but intact. The mastoid was exquisitely painful to the touch, and she was unable to secure any rest or quiet, except by the administration of powerful drugs. I felt that a mastoid operation was permissible, not only for the purpose of investigation, but also for the relief of pain. An ordinary mastoid operation was, therefore, performed August 4th, and she was discharged from the hospital August 31st, and allowed to go home with a healed mastoid the middle of September. No pathologic conditions were found inside of the mastoid bone, but she has never had a recurrence of pain since.

Remarks.—This case is reported on account of its peculiarity in many ways and as being one of the few cases where I considered that a mastoid operation was indicated for the relief of pain.

CASE VI.—P. M., age 6, first seen April 21st, 1908. Had very large tonsils and adenoid vegetations, which were re-

moved April 21st. This boy had been exposed to measles before I saw him, a fact which I did not ascertain until April 23rd, when he had an afternoon temperature of 102° and came down with an attack of measles. He was, of course, isolated in the hospital. April 24th his highest temperature was 104°. This was also his highest temperature on April 25th and 26th, which was accompanied by an almost continual cough. April 29th he complained of pain in both ears, and the next day both ears discharged profusely. His temperature kept up to 104°, and May 4th his white blood count was 20,000 and his polymorphonuclear count was 83 per cent. Streptococci were found in the discharge from both ears. May 4th his white count was 15,000 and polymorphonuclear 80 per cent. May 6th his left ear was much better, but his right ear was very painful. His temperature was 104°, white count 36,000, and polymorphonuclear 91 per cent. May 7th, the right mastoid being very painful, I did an operation for acute mastoid abscess on the right side and found considerable necrosis and much pus. His highest temperature this day was 105°. May 8th his left mastoid process became red and painful to the touch, and I made an acute mastoid operation on this side with the same result as on the right. His temperature this day was 104°. May 9th he complained of severe pain in the front and back of his head. Highest temperature was 104°, white count 11,500, polymorphonuclear 82 per cent. He became irrational during the night, and May 10th showed a positive Kernig sign and negative Widal test, as the possibility of a typhoid involvement had been brought into question by attending physicians. His highest temperature on this day was 103°. This night he was extremely restless and complained of severe pain in the back of his head and neck, and was irrational all night. The next day highest temperature was 104°, white count 10,000, polymorphonuclear 84 per cent. He complained of great tenderness along the course of the right jugular vein, and the question of a sinus operation was seriously discussed, but as he had already taken an anesthetic three times and was very much exhausted, we concluded to wait for more positive indications. A blood culture was taken and found to be negative. May 13th his condition was about the same as the previous day. May 14th, although he still complained of pain in the head, his highest temperature was 101°, white count 9800, and polymorphonuclear 65 per cent. His condition May 15th

remaining about the same, the idea of a sinus operation was abandoned. May 16th his highest temperature was 100°. He now began to improve steadily, and June 7th was discharged from the hospital and treated as an office patient. He went on to an uninterrupted recovery on both sides and retained perfect hearing.

Remarks.—This case teaches us several lessons, the first of which is before operating on enlarged tonsils, etc., we should endeavor to ascertain whether there is any reasonable danger of the possible occurrence of measles, scarlet fever, etc. This case also teaches the value of the blood count, especially of the polymorphonuclear percentage as an indication of the condition of the patient. I might add that this child came very near having a sinus operation performed, and while we should be on the alert to counsel such operations when necessary, I think the case teaches us that we ought not to be in too great haste in the performance of such a serious operative procedure.

CASE VII.—K. R., age 8. I made a radical mastoid operation on this case, which was followed by excessive granulations in the inner recesses of the bone. These were at various times curetted, etc., but they continued to form. I therefore applied chromic acid to the growths, which was followed the next day by a distinct facial paralysis, from which the patient fully recovered in about one month.

Remarks.—I mention this case because this accident never occurred to me before and, I am sure, never will again, and it shows how careful we ought to be in the application of strong caustics in the neighborhood of the facial nerve.

CASE VIII.—M. D., age 18. Patient, family and family physician, agree as to the non-existence of any previous ear disease in her life. May 12, 1908, she developed double tonsillitis with pain in left ear. No discharge, and drumhead congested, but otherwise normal.

May 20th meningitis developed with a chill, coma and a temperature of 106°. Slight discharge from left ear noticed for first time. I advised immediate operation, which was performed that evening at the hospital. A radical mastoid operation was made, and much pus and necrosis were found. The bony covering of the sinus was softened by necrosis and was extensively removed, and a perisinus abscess evacuated.

May 21st. The highest temperature was 105°. Patient

conscious at intervals. Normal salt solution administered by rectum. No ophthalmoscopic findings.

May 22nd. Temperature 105°. Much headache and restlessness and frequent mental aberration. Head shaved and Crede's ointment rubbed into scalp and retained by a head bandage. This was freshly applied for several days.

May 23rd and 24th. Condition about the same.

May 25th. She began to improve, made an interrupted recovery. Left the hospital June 16th, and was discharged as cured in September.

Remarks.—This case is reported as the patient was nearly dead when operated upon and because perisinus abscess was present. Besides this it raises the question of the possibility of Crede's ointment being of at least some benefit in cases of meningitis. Last, but not least, the blood count is shown and its value as a septic indicator emphasized.

Date.	Temperature.	Leucocytis.	Polymorphonuclear percentage.
May 20	105	29,500	93
21	103	25,600	90
22	104	24,600	89
24	103	16,000	90
25	102	14,000	85
26	101	11,350	81
27	99	10,350	80
28	99	10,300	79
29	98½	9,100	77
30	98½	9,100	75
31	98½	8,100	75
June 1	98½	8,100	73
3	98½	7,850	71
8	98½	7,000	69

CASE IX.—M. H., age 33, first seen February 27th, 1908. One week ago contracted influenza with tonsillitis on left side. She has had a chronic discharging ear for years, and had been treated by several competent men at various periods of her life without success. Shortly after the influenza developed she complained of intense pain in her left ear with extreme tenderness over the mastoid process. Pus was found in the left maxillary antrum, anterior ethmoidal cells and left frontal sinus. These were all opened intranasally, irrigated and drained. Her temperature was 100°. Her blood count showed

white cells 20,000, polymorphonuclear 89 per cent. She was sent to the hospital and put to bed and her nasal accessory sinuses and ear irrigated and treated until March 1st when, as she showed no improvement, a radical mastoid operation was performed. The entire bone was extremely necrotic. A large area of the sigmoid sinus was uncovered and the softened bone of the tegmen antri was removed, exposing quite a large area of the dura of the middle lobe of the brain. The tympanum proper and attic were extremely necrotic. The bony covering of the facial nerve was almost completely destroyed and immediate facial paralysis followed this operation. March 2nd her temperature was 100°, white count 19,000, polymorphonuclear 98 per cent. Her condition gradually improved and by March 9th she had normal temperature and a good blood count, was able to sit up and felt quite well. Her improvement continued until March 16th, when she developed profuse vomiting, and her blood count was, white cells 9600, polymorphonuclear 70 per cent. Temperature was normal. March 21st she had a distinct chill with some vomiting and temperature of 102°. March 22nd about the same condition, with white count of 6700, polymorphonuclear 73 per cent. March 23rd she developed delirium and another chill. Temperature 103°. March 24th, temperature 101°, white count 5700, polymorphonuclear 72 per cent. March 25th, another chill with vomiting. Temperature reached 104°. A spinal puncture was made, but no pus or bacteria found. March 26th the mastoid wound was reopened and the sigmoid sinus freely opened and a large streptococcus thrombus removed, and the wound partially closed. From this time on she improved in every way. On May 2nd she was discharged from the hospital and became an office patient. In about three months the facial paralysis disappeared and her ear became entirely cured.

Remarks.—This case is reported because it was a very severe case and because it gives me an opportunity of reporting the operation upon the sinus, which was entirely successful. It is also interesting because she developed facial paralysis, which became entirely cured in the usual length of time, although it was a most complete and pronounced case. The blood count is also of interest.

Case x.—C. E. S. (a physician), age 55, has had chronic purulent otorrhea on both sides for years. In 1898 left eye was hit and scratched by delirious patient, which accident was

followed by extreme exophthalmus, this condition remaining until his death, although useful vision persisted. April 18th, 1908, he was seized with severe pain in the right ear, followed by nausea and dizziness. His temperature was 103°. April 19th he fell and became almost unconscious and powerless. April 20th the same trouble appeared in his left ear. He had frequent twitchings of the muscles of both legs and arms and his tongue was thick and heavy and he had great difficulty in articulation. Temperature continued high. April 25th he was brought to the hospital and I saw him for the first time. Both mastoids were very tender to pressure. Urinalysis at this time was negative. Blood culture was negative. The discharge from his ears showed a streptococcus infection. A spinal puncture was made, showing also streptococcus infection. Blood count showed 13,500 whites and 87 per cent polymorphonuclear. Temperature 103°. He was put to bed, kept quiet, bowels open, ears irrigated, etc. April 26th his highest temperature was 99°. An operation on the right mastoid bone was proposed and performed on the morning of April 27th. A radical operation was made and much necrosis and granulation tissue was found. The sinus and temporal lobe were freely exposed, but no abnormality perceived. April 27th highest temperature was 103°. He was very nervous, sometimes delirious, sweat profusely, had frequent twitchings of his extremities and complained of great pain in various portions of his head. April 29th highest temperature was 103°. He seemed more comfortable. His eyes were examined and no optic nerve disease was found. He was examined by Drs. Wood, Hardie and Church, and a diagnosis of meningitis was made and operation advised, which was performed next day, April 30th. An ordinary mastoid operation was made and all portions of the bone thoroughly explored. Much necrosis and granulations was found as upon the right side and the sinus and temporal lobe exposed, but no abnormality discovered. At this same operation the dressings were removed from the right side and the temporal lobe and cerebellum freely exposed and explored. One or two drops of pus exuded from beneath the covering of the cerebellum and a drainage tube was put in at this point. He sank into a comatose condition immediately after the operation and died May 1st at 2 o'clock in the morning.

The postmortem was performed May 1st by Dr. H. Gideon

Wells and the patient was found to have been suffering from acute, diffused, suppurating leptomeningitis. Some turbid fluid not distinctly purulent was found on the convex surface of the brain beneath the pia-arachnoid. The convolutions were sligthly flattened. There was no fluid in the subdural space. There were no changes in the meninges on the floor of the cerebrum. The fluid of the third ventricle was turbid. The meninges of the pons was reddened. The meninges in the region beneath the cerebellum and medulla showed a small amount of purulent material. This extended along the groove between the cerebellum and hemispheres. There was a slight purulent mass over the cerebellum. The arteries were unchanged at the base of the brain. In the right border of the cerebellum was a recent operative wound about 5 mm. deep, surrounded by hemorrhagic tissue. Purulent exudate was seen along the superior line of the cerebellum. More of it was found on the cruri cerebri. The cut surface of the cerebellum showed no abnormalities. The left chorioid plexus was reddened and slightly swollen. The vessels were slightly congested and the fluid slightly turbid. The dura over the middle cranial fossae was reddened. On the left side, the temporal bone in that region seemed to be wanting and the other bone in the vicinity was rather spongy. These changes were, of course, due to the mastoid operations. On the right side the condition was the same with the addition of a pin-hole perforation at the roof of the operative incision, where the mastoid had been removed. An ante-mortem thrombus was seen at the right lateral and sigmoid sinuses. There was an operative defect in the temporal bone on the right side admitting the little finger. There was a corresponding hole in the dura and cerebellum. On removing the left orbital plate some tissue bulged up as if in tension. The ocular muscles seemed to be hypertrophied. After removing the muscles and fat tissue the left eyeball was found pushed forward by a dark reddish black mass apparently larger than the eyeball itself. This mass had a distinct capsule in which blood vessels could be seen. The optic nerve ran over the middle of this mass and was lifted up by it so that in crossing it from the optic foramen to the eyebulb it described approximately a third of a circle. The measurements in situ were as follows: Transverse diameter, 3 centimeters; antero-posterior diameter, 21 mm. The measurements after the mass was taken out were as follows: Transversely,

30 mm.; superior-inferior, 20 mm; antero-posterior, 25 mm. The mass was solid and had a consistency of about that of normal liver tissue. The tumor was not adherent to the surrounding tissues and was completely encapsulated throughout. Pictures of this interesting case are herewith submitted. The histologic examination of the tumor showed it to be a typical cavernous hemiangioma. The thrombus in the lateral sinus was probably of recent origin, as was shown by its structure, and was rich in leucocytes. Smears from the meninges and lateral ventricles showed streptococci in long and short chains and were very abundant.

Remarks.—I think no apology is necessary for reporting this interesting case. One interesting feature was the appearance of the man when first seen. With a double mastoiditis and an extremely bulging and protruding left eyeball, and with his symptoms, both subjective and objective, it would not have been difficult to have made a diagnosis of cavernous sinus thrombosis. This diagnosis, however, would have been quickly suspended, not only from a closer examination of the case, but from the fact that he had had this appearance for many years, beginning with the injury he received to his eye years ago, of which mention has already been made. In a case of this kind with no focal symptoms for a guide it was also hard to decide upon which ear to operate first. This decision was arrived at more through choice than judgment.

Something should perhaps be said with regard to the thrombus found in the right sinus. It is possible that this sinus should have been opened, but this matter was thoroughly discussed at the consultation and it was felt that his symptoms were meningitic rather than thrombotic in character. Besides this the histologic examination showed that the thrombus was of recent origin and it might have occurred only a few hours before death. In any event, it would not have altered the fatal issue of the case, as the postmortem examination showed diffused acute suppurative leptomeningitis. I do not believe that the infection reached the brain through the labyrinth, as a careful examination of the bone showed no pathologic avenue of approach. The orbital tumor, eyeball, etc., which were removed formed one of the most interesting pathologic orbital specimens I have ever seen, and for this reason alone the case is worthy of report.

CASE XI.—T. H., age 26. In February, 1908, I operated upon her for an acute mastoid abscess. In one month she was

discharged, cured. In June, 1908, she returned with a red swelling over the antrum, which was opened, pus evacuated, granulations removed and the antrum curetted as well as could be done in the office. The canal was treated, packed, etc., and an auto-vaccine (staphylococcus) used. In about two weeks she was again dismissed as cured and has not been heard from since.

Remarks.—This is another case of apparently insufficiently operated antrum. The effect of the vaccine is conjectural, but I do not believe that such a quick healing would have occurred without it. I seem to have had a flood of such cases during the year 1908, more, I think, than in all my life before. Nevertheless, I give them as they came, because I believe that they are instructive and that we often learn more from failure than success. I think I am as thorough as most operators and yet these cases have taught me to be most careful in my treatment of the antrum, both in chonic and acute cases. I also report these cases because they certainly have a bearing on the principle enunciated by Ballance, that in any case where a mastoid operation is determined upon, where the aural discharge has lasted for six weeks. the radical operation should be performed. I cannot say that I am prepared to accept this conclusion, and yet such results as are enumerated in cases two, three, four and eleven of this article certainly must make one think.

CASE XII.—Mrs. K. C., age 29. In January, 1907, she had a Heath operation performed upon her left ear. The result was entirely unsatisfactory. In September, 1908, she consulted me. There was redness, soreness, swelling and pain over the mastoid and the meatus was almost completely closed by an extensive stricture, through which it was almost impossible to pass even the smallest probe. I performed a radical mastoid operation and found the tympanic cavity, antrum, etc., back of the stricture extensively necrotic. This lady was dismissed as cured in January, 1909, at which time her hearing by the watch was three inches and for whispers 20 feet.

Remarks.—This case is reported on account of the performance of the Heath operation by a good operator, which proved to be entirely unsatisfactory in its result and which was afterwards cured with preservation of hearing by the orthodox radical mastoid operation.

CASE XIII.—A. B., age 12, a thoroughly healthy boy, was

taken ill with apparently a light attack of influenza February 21st, 1908. In a few days he had apparently recovered. March 10th he suffered severe pain in his head, accompanied with earache on the right side. A few days later he also had earache on the left side. March 16th a small amount of discharge appeared in both ears. He developed some temperature each day and about the 22nd of March began to have chills each day. The discharge from his ears ceased, the drum membrane healed, but he still complained of some pain in each ear, particularly the right. About March 20th he developed edema from both frontal sinuses until about the 24th of March, when his eyelids were completely closed. He complained of great pain in the back of his head and through the forehead. From the beginning of his trouble he complained that it hurt him to open his jaws and masticate food. He was taken to the hospital March 25th, with temperature of 103°, white count 20,000, polymorphonuclear 80 per cent. His right drum membrane was incised, but no pus escaped.

I saw him first on March 27th, 1908. (He lived in another State.) He had hardly any mastoid symptoms, no pain, tenderness or swelling of the posterior-superior wall of the meatus, no ear discharge, no redness of the drum membrane. The redness and swelling over the frontal sinus would have led one to suppose that if any operation was to be done it should be made there. Consequently, an exploratory opening was made into the right frontal sinus, but nothing found. I then opened the right mastoid process and found some necrosis and very little pus. This day his highest temperature was 103°. March 28th his condition was no better. Highest temperature 103°, lowest 102°, white count 16,000, polymorphonuclear 87 per cent. He had severe chills on this day. March 29th his highest temperature was 102½°, lowest 99½°, white count 18,000, polymorphonuclear 84 per cent. I was requested to see him that night, but was unable to do so and sent my partner, Dr. Frank Brawley, who thoroughly examined the accessory sinuses and found nothing abnormal. He therefore opened the left mastoid process and found considerable necrosis, pus and granulation tissue. March 31st his highest temperature was 100°, lowest 98½°. He had several chills and complained of great soreness near the right breast. April 1st his highest temperature was 100½°, lowest 98½°, white count 18,000, polymorphonuclear 80 per cent. April 2nd temperature about the same, with chills. The family surgeon

opened a swelling near the right breast, but found no pus. I saw him again April 3rd, at which time he complained of severe (right) earache. On this day his highest temperature was 102°, lowest 98½°. He was having chills. At the site of the right mastoid operation I opened the right sigmoid sinus, from which blood instantly escaped and forced out a small streptococcus thrombus. April 4th his highest temperature was 98½°, lowest 97½°, pulse as low as 58, white count 8700, polymorphonuclear 81 per cent. April 5th highest temperature 98½°, lowest 97½°, pulse 60, white count 7000, polymorphonuclear 83 per cent. April 7th highest temperature 98½°, lowest 97½°, pulse as low as 60, white count 6000, polymorphonuclear 77 per cent. His urine now showed blood, albumin and casts. April 9th his white count was 8000, polymorphonuclear 75 per cent. April 14th white count 6000, polymorphonuclear 71 per cent. April 22nd white count 10,000, polymorphonuclear 66 per cent. His urine cleared up gradually. April 25th he left the hospital and in a few weeks entirely recovered.

His blood was examined at various times during his illness, from which, together with the examination of the thrombus, the infection was shown to be streptococcus in character. The swelling over the frontal sinus gradually disappeared. He had at various times throughout his illness very slight mental aberrations.

Remarks.—This case is worthy of record, because it shows what serious pathologic conditions can occur without adequate objective symptoms. The diagnosis in this case was exceedingly blind. There were practically no symptoms to cause one to suspect a mastoid or sinus involvement and yet reasoning by exclusion there seemed to be no other cause for his profound infection. Each operation was made with the feeling that very likely it was an unnecessary procedure, but with the exception of the exploratory incision into the right frontal sinus, none of the three major operations were unnecessary, as pus was found in both mastoid cells and a streptococcus thrombus in the right sigmoid sinus. Cases like this should show us that even though there is no redness, swelling or pain over the mastoid process, and while the drum membrane may look healthy, there may still be a serious infection going on inside of the bone demanding operative interference. The consistency existing between his blood count, his infection and his general condition are also worthy of record.

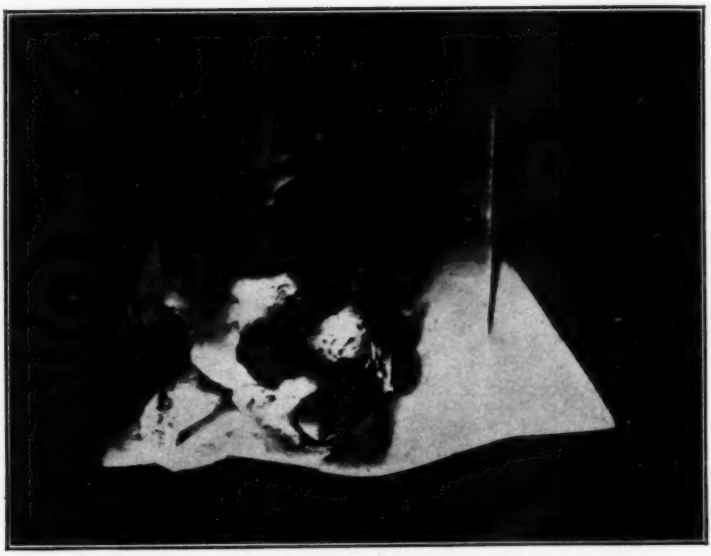

FIGURE 1.

FIGURE 2.

FIGURE 3.

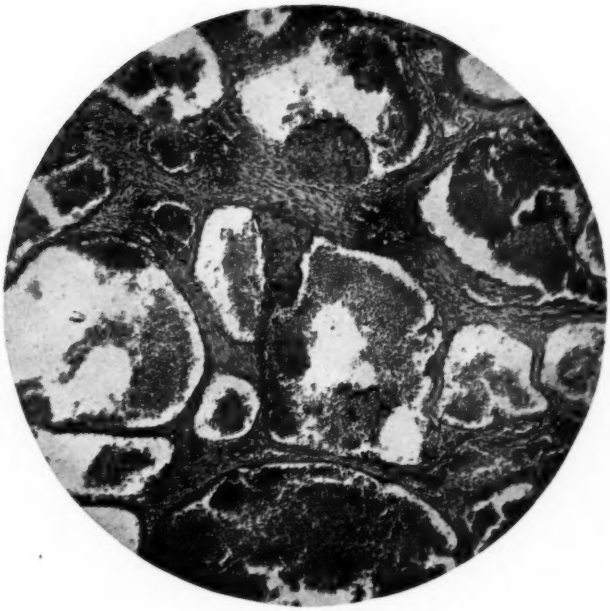

FIGURE 4.

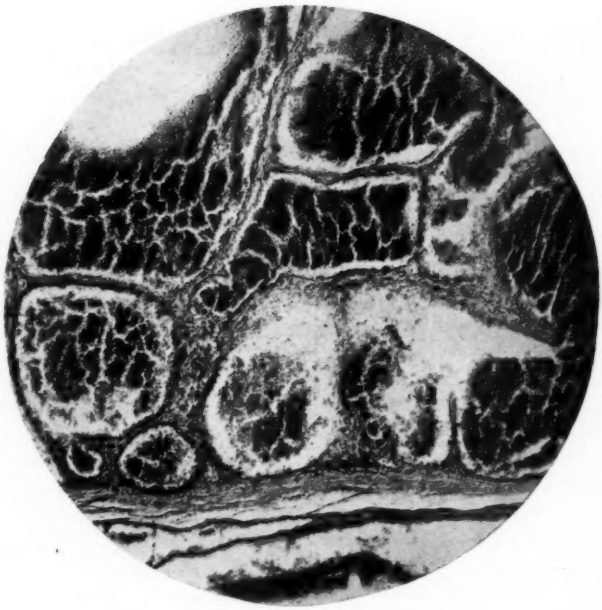

FIGURE 5.

VII.

VINCENT'S ANGINA.

By Charles W. Richardson,

Washington.

I would describe Vincent's angina as a peculiar type of ulcero-membranous lesion affecting the mucous membrane of the fauces and occasionally the buccal and pharyngeal mucosa, in all probability due to the activity of a dual organism. This type of angina affects most frequently the tonsils, palatine folds and uvula. It also occurs in and about the gums, tongue and pharynx. Without going extensively into the history of this affection, it will be sufficient to state that Vincent, in 1896, gave apparently the first definition of the disease, describing the microorganism present, with histories of cases. The disease since then has been known as Vincent's angina. Vincent's right to the priority of description is questioned through a study of similar conditions by H. C. Plaut and reported by him under the title, "Studies Regarding the Bacteriological Diagnosis of Diphtheria and the Anginas." Plaut gives credit to Miller for the discovery of the microorganism made in 1883. Bernheim in 1898 published a paper evidently upon independent research in which he described thirty cases, in all of which the characteristic microorganisms were found. A number of interesting papers have oppeared in the French and German journals, describing this lesion and citing cases during the past two years. In America several excellent papers have appeared describing this interesting condition. It is my belief that the angina is not as generally known and recognized as it should be. I feel also quite firmly convinced that its occurrence is not quite so rare as many observers seem inclined to believe. The importance of disseminating knowledge with regard to the occurrence of this affection, its characteristic lesion, its diagnosis and differentiation become manifest when we recognize how readily it can be mistaken for syphilis or diphtheria. It is also interesting to note the almost universal absence of the consideration of this type of angina in all the recent text books on disease of the nose and throat.

This type of angina is apparently due to the presence of the Vincent's bacillus, a fusiform bacillus, and a spirillum. The fusiform bacillus designated by Vincent as the bacillus fusiformis is from 7 to 14 mikra in length and 1 to 2 in greatest thickness. This microorganism is readily recognized, as there is no other germ occurring in the mouth that is quite like it. It is described by some as motile, by others as non-motile.

The spirillum is a true spirochaete. This organism is stated to be motile. All culture experiments so far have been attended with uniform failures. The most striking feature of this disease is the dual association of two such dissimilar microorganisms.

Most of the authorities which I have consulted show a large preponderance in reported cases as having occurred in children. This may due to the fact that many of those who have made reports of cases are pediatricians. In my experience the disease has been entirely manifested in young adults, and almost exclusively limited to the male sex.

The angina is usually ushered in by slight general disturbance. The fever is rarely high and only endures for two or three days. There are thirst, impairment of appetite and slight headache. Locally the most annoying symptom is pain, which is very intense, and most of my patients have sought relief on account of this pain. Dysphagia is also quite pronounced. The breath is usually foul. The local appearances are quite characteristic. It is described as occurring in a diphtheroid form, which rarely extends beyond the mucosa and in an ulceromembranous form which is quite extensive in its destructive influence. The local evidence in the fauces is generally manifested in the upper angle of the tonsils and the neighboring portion of the arch and uvula. I have never seen the diphtheroid variety, all of my cases having been of the phagydenic form. It is described as being limited to one tonsil, and such has been the rule observed in my cases, except in one individual in whom both tonsils were affected, and who also had a recurrence in both tonsils a couple of months after recovering from the primary attack. The appearance of the affected area of the tonsils is more that of a sloughing ulcer than of a membranous deposit. The mucous area contiguous to the ulcer is only slightly congested and there is no infiltration of the tissue. The surface of the ulcer is slightly depressed and of a faint cream color, the edges are quite irregular and inflamed. The

use of a curette will demonstrate how deep the slough has extended. Under the use of the curette the slough comes readily away, leaving an irregular granulating cavity, often extending to the capsule in depth and frequently involving half or more of the tonsil in extent. The slough has more the appearance, to me, of very finely broken-up bread crumbs which have been moistened. The pillars of the fauces and the uvula are occasionally involved in the destructive ulceration. The lymphatic glands in the neck and submaxillary region on the side affected are frequently enlarged and painful. The local symptoms usually persist for a period of one to two weeks. The exudate in its reaction to litmus is slightly acid.

Complications.—There is no doubt that Vincent's angina may be complicated with or complicate other conditions of a zymotic type in the mouth and fauces, such as diphtheria, scurvy, scarlatina and syphilis.

The prognosis is usually favorable as to life. There may be more or less destruction of the tonsils and adjacent tissue. In one of my cases the tonsil was completely destroyed. H. W. Bruce, of London, narrates a case terminating with death. Relapses occur and one attack does not confer immunity.

It is interesting to note that Vincent states that, in some cases of hospital gangrene and ulcerative stomatitis observed by him in Algiers, he found in great numbers a bacillus and spirillum, which, in their form, their straining reaction and in their resistance to all efforts to cultivate them, were identical with the microorganisms found in the condition which we are describing.

The Diagnosis.—The clinical evidences are so characteristic in many of the cases coming under observation that there should be no difficulty in recognizing this form of angina. Examination of smears will enable one to come to a positive diagnosis. If a properly prepared smear shows no Vincent's bacteria there can be no Vincent's angina, for the germs of this disease are present from the initial lesion and persist over the surface, indeed until after the ulcer is healed.

The treatment which I have found most efficacious is the curetting out of the slough, the use of cleansing antiseptic solutions and the daily application of a five per cent solution of nitrate of silver.

These observations are made from the study of fifteen cases which have come under my notice.

VIII.

BRONCHOSCOPY AND ESOPHAGOSCOPY—THE TECHNIC, UTILITY, AND DANGERS.*

By E. Fletcher Ingals, M. D.,

Chicago.

The history, anatomic conditions, instruments and technic of this procedure have been so admirably presented and in such detail by Chevalier Jackson in his excellent monograph on the subject that I need not take your time with a exhaustive paper.

I shall therefore present only those features that appear to me of special importance to the operator, but in doing this I shall necessarily repeat some things that I have said before and also some that are dwelt upon by Jackson and other authors. I feel that much has yet to be done in the development of this most valuable operation, especially in learning to avoid its dangers.

Before attempting bronchoscopy on the living patient, one should make every possible effort to acquire dexterity by practice with the tubes, lights and forceps. For a beginning one may practice with a tube, the distal end of which is held in the closed hand. In this way he may learn something of the difficulties and the means of overcoming them; but the view thus abtained is much more distinct than in a congested and swollen bronchial tube, more or less filled with secretions and blood. The same statement applies to rubber manikins designed to represent the trachea, bronchi and esophagus, and it appears to me that they are little if any better than the closed hand. Practice on the cadaver is only a little more valuable than the methods just spoken of, because the pale dry, motionless air tubes are so very different from the conditions found

*Abstract of paper read at the Southern Section of the American Laryngological, Rhinological and Otological Society, Richmond, Va., February, 1909.

in the living patient. A medium sized dog furnishes the best subject for practice.

Diagnosis.—The diagnosis should be as carefully made before attempting this operation as before almost any other surgical procedure. We must inquire very carefully into the history. The physical examination should be thoroughly made and every laryngologist should be an expert diagnostician of thoracic diseases. Metallic bodies, pebbles, bone and glass as well as some of the more compact organic substances cast shadows which may be more or less readily seen in a good radiograph. These can sometimes be seen with the fluoroscope. Seeds, small pieces of wood, particles of food, etc., do not cast shadows. With no history excepting that of a suddenly developed cough, a radiograph will sometimes reveal a metallic foreign body, as in a case I have seen recently where the friends had no suspicion that anything had been inhaled, yet a small nail was found in the lung.

Having established the diagnosis beyond a reasonable doubt, the next question is whether one shall perform an upper bronchoscopy, through the nasal passages, or a lower bronchoscopy through an opening in the trachea. I have come to believe that whenever marked dyspnea is present, safety to the patient demands a preliminary tracheotomy. In other cases it would generally be better first to attempt upper bronchoscopy. Where the foreign body is deeply seated in the lung and at a considerable distance from the median line, especially if upon the left side, lower bronchoscopy would nearly always be better. Experience has led me to believe that in nearly all cases, unless one succeeds in finding the foreign body within 10 or 15 minutes by upper bronchoscopy, the trachea should be opened, because lower bronchoscopy is much less difficult than the upper; for the tubes may be better illuminated, they can be more easily passed into the bronchi, and shorter and larger tubes may be employed. It would generally be safer to defer the lower bronchoscopy a few days, until all irritation has ceased.

Anatomy.—A knowledge of the anatomy and physiology of the air passages and esophagus are essential to good results in bronchoscopy and esophagoscopy. The teachings of the older anatomists were misleading, especially regarding the trachea and bronchi and the majority of physicians (even laryngologists) have not had their attention called to the errors. The demonstrations of Aeby (Der Bronchialbaum des Menschen

und der Saugetiere, Leipsig, 1880), which have since been confirmed by other anatomists and are now generally accepted, show that the teachings of the older anatomists that the right bronchus runs nearly horizontally into the right lung and the left much more obliquely downward into its lung are rarely if ever correct. Prof. R. R. Bensley, of the University of Chicago, confirms Aeby's statements, and Prof. J. Gordon Wilson, formerly of the University of Chicago, now of the Northwestern University Medical School, from numerous recent dissections, has arrived at nearly the same conclusions. There is considerable variation in the direction of the bronchi in different individuals, but in a considerable proportion the right runs at a much smaller angle from the median plane downward and backward into its lung than does the left. In some cases indeed, the right bronchus is almost a direct continuation of the trachea. The left bronchus turns more nearly horizontally to the side running downward and backward. Aeby states that on an average the right bronchus makes an angle of 24.8 degrees to the mesial plane, whereas the left bronchus diverges on an average of 45.6 degrees to this plane; in children the bronchial angle is less than in adults. The left bronchus which is in the adult about 10 mm. in diameter, is usually from 1 to 2 mm. smaller than the right bronchus, but it is nearly twice the length of the latter, and not infrequently its first branch which passes upward and outward to the upper lobe, is even larger than the continuation of the main stem. This branch is usually larger than the corresponding branch of the right side, its average diameter being 9 mm. Prof. Wilson's observations show that the first branch from the right main bronchus runs downward and outward to the upper lobe of that lung, and that it averages 8.5 mm. in diameter.

It was formerly taught that the bronchi divide and subdivided dichotomously. It would generally be better to consider the bronchus of each lung as one main stem starting at the bifurcation of the trachea, running downward, more or less backward and outward toward the posterior part of the lung to a position about 8 cm. from the middle line of the body. From these main stems large branches are given off to the upper lobes, which shortly give off two or more smaller branches. Upon the right side a branch is also given off to the middle lobe. The main stems also give off branches arranged in anterior or ventral and posterior or dorsal sets. The

ventral, which are also the outward of these branches, are often nearly as large as the stem from which they are given off. The branch to the upper lobe on the right side is usually given off about 1.5—2.6 m. from the beginning of the main bronchus, but that on the left is given off at about 5 cm. from its origin. The left main bronchus generally runs more nearly horizontally than the right, and it is probably from this condition that foreign bodies lodged in the branch going to the left upper lobe are often much more difficult to detect than those in the subdivisions of the right bronchus; indeed, in not a few cases, owing to the position of this branch, the congestion and swelling of the mucous membrane and the secretions and the blood in the bronchi, the operator will be unable to detect foreign bodies in this bronchus at all. The dimensions are:

	Average length and size. Adult.			
	Male.	Female.	Child.	Infant.
Diameter of trachea	14-20mm.	12-16mm.	8-10mm.	6-7mm.
Length of trachea	12 cm.	10 cm.	6 cm.	4 cm.
Length of right bronchus	1.2-2 cm.	1.2-2 cm.	1.3 cm.	1 cm.
Length of left bronchus.	4.5 cm.	4.5 cm.	3 cm.	2.5 cm.
From upper teeth to trachea	15 cm.	13 cm.	10 cm.	9 cm.
From upper teeth to bifurcation of trachea.	27 cm.	23 cm.	16 cm.	13 cm.
From upper teeth to secondary bronchi going to the upper lobes of the lungs	29-32 cm.	25-28 cm.	17-19 cm.	14-15 cm.
From upper teeth to branches going to lower lobes	32-35 cm.	28-31 cm.	20-23 cm.	

From recent dissections on adult bodies, Prof. Wilson furnishes the following table:

Right bronchus.	Distance from bifurcation of trachea.	Diameter.
Branch to upper lobe of lung	1.2 cm.	10 mm.
Branch to middle lobe	4. cm.	8.5 mm.
Main bronchial stem at this point.		8-9 mm.
First lateral branch to lower lobe.	4.3 cm.	4.5-6.5 mm.
Left bronchus.		
Branch to upper lobe of lung	4.8 cm.	9 mm.
Main bronchial stem at this point.		8-9 mm.
First lateral branch to lower lobe.	5.6 cm.	6 mm.

These measurements, however, are only approximate and are subject to much variation. They do not allow for the dilatability of the air tubes during life, nor do they allow for the

contraction. The dilatation that can be done with safety is, I think, very little, but unfortunately for the operator, the expiratory contraction of the bronchi, especially in the young, and the swelling of the mucous membrane, may make the tubes very much smaller than they would be in the cadaver. It is especially important to know the length of the trachea and bronchi and the probable distance from the upper teeth to the bifurcation of the trachea and to the first and second divisions of the bronchial stem.

Usually the bronchoscope should be from 4 to 6 cm. longer than indicated by these measurements in order to allow for error in the estimate and for convenience in manipulation. Occasionally tubes much longer than just suggested will be needed. Jackson states that to reach below the first branches of the main bronchi tubes 45 or 50 cm. in length will sometimes be required. I call special attention to this because I was obliged to learn it by painful experience. Throughout the lungs the pulmonary arteries and veins accompany the bronchi. The bronchial arteries and veins also run along the posterior walls of the bronchi.

Preparation.—Careful aseptic precautions should be taken for this operation, even though perfect asepsis cannot be secured because there are so many microbes constantly in the mouth; yet, we must protect our patients from every avoidable risk. Jackson very properly suggests that when lower bronchoscopy is to be done, it is advantageous to do it immediately after the trachea has been opened, for if delayed a few days there is more chance of carrying infection to the lower portion of the lung from a suppurating tracheal wound.

In doing bronchoscopy, I have several times received severe electric shocks, and I suspect that patients have also received them. For this reason it is desirable to have a table with rubber castors and to have the floor covered with rubber sheets, so that the operator and all the assistants will be insulated; or everybody who is about the patient should wear rubbers and rubber gloves.

It is desirable to have two or three sources of light, all of which should be carefully tried out before the operation, otherwise at a critical point one may be left in darkness. All have their advantages and defects. I think that the secretions and blood getting into the auxiliary tube of Einhorn's or Jackson's bronchoscopes make it more difficult to keep the lamps clean

than when they are introduced through the bronchoscope. The main objection, however, to Einhorn's and Jackson's bronchoscopes is that they necessitate using an instrument 1 or 2 mm. smaller in caliber than the Killian bronchoscope that could be employed in the same case. Usually the largest size that can be safely used is needed. I have used the Kirstein and Killian lights and Jackson's and my own small lamps, and I have at least two kinds in readiness at each operation. In one operation both of them gave out at the same time before I had finished. I have used the street currnt with reducing rheostats for all of these lamps, but I believe we should adopt Jackson's suggestion and use only a primary battery for the small internal lamps, because by this method the patient could not get a severe shock. It is also important that the conducting cords for the aspirator pump and the various lights should not come in contact with each other.

An aspirator for removing the secretions and blood or pus from the bronchi is provided with most of the sets and is important, but the hand aspirator acts slowly and not very satisfactorily as compared with a small pump driven by an electric motor. I have used with great satisfaction the pump which I think was devised by Dr. Jackson for the purpose of massage for the ear drum.

A gag is necessary. Killian's split tubular spatula or Jackson's tubular spatula, one side of which may be opened by removing a slide, or my similar open-tube spatula, are very helpful in introducing the bronchoscope, though in most of my operations I have used my introducer. I have used Killian's, Bruning's and Jackson's bronchoscopes, but on the whole I like Killian's the best. The size of the bronchoscope will depend upon the age and size of the patient, the larger the tube that can be used with safety the better. In infants, for upper bronchoscopy, the tube should not exceed 5 mm. in diameter. In older children it may be 6 or 7 mm., and in adults 9 mm. in diameter. Ordinarily, for children, bronchoscopes 7 mm., for adults 9 mm. in diameter are employed. Mandrins are usually desirable, that will just fit these tubes, with smooth ovoid ends projecting beyond the bronchoscope, and that are so made as to allow the patient to breathe through them. It is important, too, that the bronchoscope should have several openings through its wall, beginning about 4 cm. above the distal end, in order that when one bronchus is closed by the tube, the

patient may respire through these openings. A number of cotton holders long enough to reach through the bronchoscope must be on hand, and they should be so made that the cotton will be fastened firmly. I have used only the cotton holders furnished with Killian's set, but those devised by Dr. Coolidge that are fastened by a ferrule which is screwed down, are better. Numerous forceps have been devised, any of which, if small enough and long enough, may be satisfactory to different operators. I like the Killian forceps best. Different forms of blades are necessary, according to what is to be accomplished. Blades that will grasp firmly any small object, are essential, others that when closed have 4 to 5 mm. between them are necessary in removing such objects as peanuts and beans, in order that they be not crushed. Cutting blades are occasionally needed and blades roughened exteriorily that may be introduced within tubular objects and then sprung out so as to hold them, are sometimes necessary. Blades that may possibly do damage by catching and tearing the soft tissues, should not be employed, if it is possible to get along without them. In two or three cases I have derived great advantage from a little instrument that I have named a pin finder, made somewhat on the principle of a corkscrew with a blunt end, the object of it being to work the pin as nearly as possible into the center of the lumen of the bronchus, so that the bronchoscope may be slipped down over it. Ingenious safety pin closers have been devised by Mosher and Jackson. Various hooks are also recommended and will sometimes be found very useful, but I wish specially to caution operators against the use of a hook bent so far that it may possibly catch into a bronchus. A hook 4 mm. across could easily be passed into a bronchus only 3 mm. in diameter, but on attempting to withdraw it, it might catch into a branch of this small bronchus, and in such case it might be impossible to disengage it without tearing the lung. Tearing the lung in this location would almost necessarily result in emphysema, which would probably prove fatal; it might be attended by serious hemorrhage, or it might be the starting point of a dangerous broncho-pneumonia or pleurisy.

A sterilized tracheotomy set should always be on hand in case it should be necessary to open the trachea. An O'Dwyer's intubation set is sometimes valuable. In a recent bronchoscopy I accomplished the same end very quickly by introducing my tubular director 5 mm. in diameter through the glottis.

I think it will be better for emergencies than either of the others. For the removal of granulation tissue and tumors, small curettes set at right angles to the stem are very useful.

Anesthetic.—Local anesthesia has been relied upon largely by Killian, von Schroetter and others, but I have preferred general anesthesia. For short examinations, cocain and suprarenaline are better where the patient is not too nervous; but in children general anesthesia appears preferable, though von Schroetter told me that he relied on local anesthesia even for these little patients. Chloroform is usually employed as a general anesthetic. Before beginning an operation, a moderately full dose of morphin and atropin, appropriate to the patient's age and size, will make it possible to get along with a smaller quantity of the anesthetic, and at least in adults I believe will render the operation safer. The use of cocain combined with some of the suprarenaline products also enables one to get along with smaller quantities of the general anesthetic. In my operations the patients have not been kept profoundly under the chloroform. Some operators consider cocain perfectly safe, but from the numerous unpleasant symptoms that I formerly saw when using it in the nose and from many recorded fatal cases of cocain poisoning, it seems necessary to employ it with considerable caution. Two fatal results following bronchoscopy in children in whom I employed cocain, and in one or both of whom moderate amounts of morphin and atropin were also used, have made me fearful about these drugs, although I have not yet been able to reach any satisfactory conclusion as to the exact cause of death in either case.

Technic.—Dr. Jackson gives very precise instruction about the arrangement of tables and the positions of the various assistants. I have found it important to have a reliable man to hold the patient's head; indeed, I feel that my first difficult bronchoscopy was successful largely because my assistant held the head in such a vise-like grip when it had been placed where I wished it, that it did not move.

Nearly all of my bronchoscopies have been done with the patient lying upon the back, the head hanging over the end of the table. Killian and von Schroetter have done nearly all of their bronchoscopies under cocain, and I judge have usually had the patient in a sitting position.

Care must be taken that the bronchoscope does not injure the patient's lips; this may be avoided by placing a folded

napkin under it over the teeth, or the lip may be watched by an assistant.

Whatever method is employed in the introduction of the bronchoscope, one should be careful not to get it into the esophagus, which is much easier to enter than the larynx. If the tube should be passed into the esophagus, it must always be cleaned and again sterilized before again attempting to pass it into the trachea.

Among the difficulties that will be met in doing bronchoscopy are: rigidity of the neck, especially when only a local anesthetic is used, spastic muscular contractions, cough and excessive secretions, and respiratory difficulties due either to the foreign body or to the inflammation it has caused.

When the bronchoscope has entered the trachea, it should be passed down gently while carefully inspecting the parts until the antero-posterior septum at the bifurcation is found; then it should be inclined to the right or left, according to the lung that we wish to enter, the head and neck being turned at the same time in the opposite direction and the bronchoscope to the opposite side of the mouth so as to minimize the strain on the trachea and bronchi. In most cases there will be little difficulty in finding the main bronchus, but sometimes the lower portion of the trachea is filled with secretion that must be removed before the parts can be seen. In young children the trachea may contract in expiration in the same way that the bronchial tubes do in adults, therefore it will not always be found easy, even to get into the main bronchi; but generally the operator, after a little experience, will not have much trouble in this respect. In passing the bronchoscope into the right lung, we expect within about 1½ cm. of the bifurcation, at its upper outer part, to find the mouth of the bronchus which supplies the upper lobe of the lung. On the left side, after the bronchoscope enters the main bronchus, it should be passed along gently for 4 or 5 cm., while the operator carefully inspects the upper outer wall for the beginning of the branch going to the left upper lobe.

There are numerous branches given off the main bronchial stems, but it must not be supposed that the operator will be able to recognize the orifices of all of them. Three to five at most are all that can usually be seen on either side.

The operator is sometimes confused by the reflections of light from the inner surface of the tube. This is best overcome

by employing a small lamp carried down to the end of the bronchoscope. The secretions and pus or blood in the trachea or bronchi may prevent inspection of the parts, and sometimes it is very difficult to remove them sufficiently to make a thorough examination. Vision is not infrequently interfered with by swelling of the mucous membrane or granulation tissue, sometimes by contraction of the bronchus above the foreign body by cicatricial tissue, and it is always more or less interfered with by the normal contractions of the bronchial tube that may be exaggerated or may even be continuous in the presence of a foreign body. Foreign bodies, after remaining for a long time in the air passages, may become encysted, so that they cannot be seen at all. Gentle probing may enable the operator to discover the foreign body. I like best for this purpose the long slender tube that I generally use for aspirating the secretions.

In the case of small bodies like pins or needles, the pin finder will someties bring them into view and enable one to pass the bronchoscope over them so that they can be grasped by the forceps. Small bodies in small bronchi may very easily escape detection, especially when they are not of metallic character, so that their location can not be determined by the radiograph.

One is not justified in searching long through the bronchial tree unless he is sure that a foreign body is present. Foreign bodies lodged in the branches of the bronchi that run to the upper lobes, especially that of the left lung, have in my experience been the most difficult to detect.

Utility.—Bronchoscopy may be valuable in the diagnosis of some conditions of the upper respiratory passages when they cannot be determined by other means; thus in certain cases we may discover involution of the trachea from the pressure of a goitre, enlarged thymus, aneurism or other mediastinal tumor. I am fully convinced, however, that simply for diagnosis this method should seldom be used excepting where an accurate diagnosis cannot be made by ordinary laryngoscopy and the usual methods of physical examination.

Bronchoscopy is of greatest value for the detection and removal of foreign bodies from the larynx and tracheo-bronchial tree. Most foreign bodies, after they have been located, can be best grasped with tubular forceps, the blades of which cannot damage the surrounding tissues. The forceps should be marked by a narrow strip of adhesive plaster wound around it

so that the operator may know when it reaches the lower end of the tube. Having located the foreign body, one may sometimes grasp it while it is in plain sight, but commonly the forceps so obstruct the view that this is difficult. In such cases, if a forcep is used that has no sharp teeth to injure the lung, the instrument may be passed down in such a position that when the blades are opened they must pass on each side of the body; then when the mark upon the stem shows that the end of the forceps has nearly reached the body, the blades are opened and the instrument passed in about 1.5 cm. farther, when the blades may be closed with as much assurance of catching the object as though it were under direct inspection. However, where the body is of such a nature that toothed or cutting forceps must be used, it should not be touched excepting under direct inspection.

Laryngeal tumors can sometimes be removed by direct laryngoscopy more easily than by the older method, especially in children, or in other patients where a general anesthetic is necessary. Whenever operations of this kind are to be done, they should usually be preceded by tracheotomy. Laryngeal stenosis from cicatrices may sometimes be readily relieved, and tracheal tumors or granulation tissue can be removed by this method. Stenosis of the trachea or bronchi has occasionally been satisfactorily treated by the aid of the bronchoscope. Edema of the larynx may be easily reached and relieved by the tubular laryngoscope. Abscesses of the larynx that cannot be opened in the ordinary way will often be found amenable to treatment by this method. Ulcers of the trachea and the bronchial tubes have been cured by the aid of the bronchoscope that could not be reached in other ways.

It has been suggested that cavities in the lungs might be satisfactorily explored and treated through the bronchoscope. While believing that this could be done in exceptional cases, I think that the exploration would not be justifiable unless there was reason to believe that the cavity contained a foreign body.

Dangers.—Those who have had a few successful cases of bronchoscopy are apt to become very enthusiastic over its possibilities without recognizing its dangers, and therefore it has been recommended in many conditions where it is not indicated. At first sight it appears a simple thing to pass a small tube through the trachea into the bronchi, and it would seem that

if the operation were done gently, no harm would result. It has been shown, however, that the operation is far from being either easy, simple or devoid of danger. The primary danger comes from the anesthetic, which if general becomes especially hazardous in the presence of dyspnea. Most operators who rely on local anesthesia speak of it as perfectly safe, but one cannot understand how they overlook the possible dangers from the absorption of cocain, when numerous fatal cases have resulted from its use in other parts of the body. It would seem that cocain applied so closely to the nerves controlling the respiration and circulation might have a serious effect; a general anesthetic when the patient is suffering from dyspnea is attended by much danger, especially, unless tracheotomy has first been performed; but in any case it is important that the anesthesia be not too profound or too long continued. Even though only small amounts of chloroform are used, I have come to believe that it is not safe to continue the operation for more than half an hour, even though not more than from 3 to 8 minutes may be available for actual inspection. It may be that even less than this should be placed as the limit.

In spite of the greatest care a certain amount of local traumatism will occur which may be the starting point of a fatal broncho-pneumonia. Should hooks or other instruments become caught in any part of the air passages, so that a little force is required to remove them, the lung is liable to be torn in such a way that the air will pass out, causing either an emphysema or a pneumothorax and pleurisy, either of which may prove fatal. Patients are known to have died soon after bronchoscopy from pneumothorax, emphysema, or pneumonia and other conditions; and if the operator is blind to the dangers it is natural to attribute these fatalities to the foreign body or to the anesthetic rather than to the operation. Pulmonary edema has apparently been the cause of death in several cases, and edema of the larynx has sometimes necessitated a sudden tracheotomy. Dangerous bronchitis has also occurred. The two deaths that I have already referred to from unexplainable causes have suggested to me also that danger may arise from electric shocks communicated to the patient through the instruments.

When we consider the relation of the blood vessels to the trachea and bronchi and the very short distance from the lumen of these tubes to the intracellular pulmonary tissues, we must

realize that it would not be safe to tear or cut anything within the tracheo-bronchial tree unless we were absolutely sure that it would not open a way for air to pass out into the pleura, mediastinum, or lung tissue.

Jackson found a mortality of 9.6 per cent, but by eliminating 6 cases that he thought would probably have died without the operation, the mortality would have been 3.2 per cent. This does not appear to me a sufficiently conservative analysis of the statistics; on the contrary the chances are greatly in favor of the mortality being much larger than 9.6 per cent. Of the 6 cases that he would eliminate, no one can be certain that any of them would have died without the operation, and we may be certain that some, probably a majority of the fatal cases observed by others, have never been reported.

Notwithstanding all of the dangers, I believe that this operation is of great value in many of the conditions that I have enumerated, though it should be done with extreme care and gentleness. It is indicated in nearly all cases in the presence of foreign bodies in the air passages. Many foreign bodies can be easily removed by tracheotomy, but it would be better to try bronchoscopy first, provided there were not severe dyspnea, and in every case where the foreign body cannot be extracted by tracheotomy, bronchoscopy is surely indicated. In the other affections mentioned this operation is often indicated, but the condition of the individual patient and the experience and good judgment of the laryngologist must determine what course should be adopted.

Esophagoscopy.—Those interested in the history of this operation I will refer to Jackson's monograph. The instruments that are employed are essentially the same as those for bronchoscopy, though the tubes are larger, and many of them shorter, and occasionally they are made oval instead of round. The instruments for the removal of foreign bodies or neoplasms from the esophagus, would be the same as those employed in bronchoscopy.

Esophagoscopy is done much more satisfactorily and pleasantly when the patient is fasting than at any time within a few hours after a meal.

Cocain with one of the suprarenaline products may be used as an anesthetic in a large number of these cases, but in children and sometimes even in older subjects, it is better that a general anesthetic be employed. Either chloroform or ether

can be used, as we will not have to consider the effect of the anesthetic upon the lungs in esophagoscopy as we do in bronchoscopy.

The tubes that are employed for esophagoscopy may be about 25 per cent larger than those that would be used for a similar patient in bronchoscopy. A large percentage of the diseases of the esophagus occur in the upper portion of this tube, and foreign bodies are likely to lodge just behind the cricoid cartilage or immediately below that point, so that comparatively short tubes are generally employed. The oval esophagoscope gives a larger field for inspection than the round, and according to the area exposed, it is introduced considerably more easily than the round instrument. In either case, an obturator is desirable, unless the part to be examined is near the mouth of the esophagus.

From its mouth to about the level of the upper end of the sternum the esophagus is closed, the slit indicating its lumen being directed from side to side.

As the esophagoscope is passed gently the walls of the esophagus seen across the end of the tube present a mucous membrane, only a few shades deeper in color than the laryngopharynx. When the instrument has passed a little below the upper end of the sternum the esophagus is usually found to be an open tube that contracts and expands more or less with the respiratory movements. This tube continues open down to near the cardiac orifice of the stomach. In the adult it usually appears from 8 to 10 mm. in diameter.

Esophagoscopy is of value in the diagnosis of strictures, diverticula and malignant or other growths, however the danger of rupturing the walls of the esophagus must always be borne in mind because in these conditions they sometimes tear very easily and such a tear is likely to be quickly followed by a fatal pleurisy or mediastinitis.

The operation is of special service in the diagnosis and removal of foreign bodies or tumors from the esophagus. Sometimes in this operation the edematous mucous membrane rolls down over the foreign body so as to completely hide it, even though the esophagoscope may easily pass all the way down to the stomach, therefore, wherever possible a good radiograph should be taken before the operation is attempted. It should be remembered that coins or other flat foreign bodies in the esophagus practically always have their flat surfaces

antero-posteriorly. A knowledge of this fact aids the surgeon greatly in searching for them and in their removal. Failure to find a foreign body as large as a nickel in the esophagus by esophagoscopy should not convince the operator that it is not present, because the swollen mucous membrane is very likely to be crowded down over it in such a way as to hide it.

There can be no question but that this operation is by far the best for nearly all cases of foreign bodies in the esophagus, though if one is so large that it cannot be removed when discovered, it may be necessary to do esophagotomy; however, some objects of large size have been successfully cut and then removed in pieces by the aid of the esophagoscope, with much better results to the patient than would probably have attended an esophagotomy. Esophagotomy has a much larger percentage of mortality than operations through the esophagoscope and therefore whenever possible, a skillful laryngologist should be called upon to remove foreign bodies before resorting to esophagotomy. It is certain that most foreign bodies that become lodged in the esophagus can be removed with very silght danger to the patient by aid of the esophagoscope. Neoplasms that can be secured in a snare may commonly be safely removed in the same way; those that would require the use of cutting instruments must be handled with extreme care, and ordinarily they are not suitable for this operation. Strictures of the esophagus that could not be managed with ordinary bougies might sometimes be overcome with the aid of the esophagoscope and as diverticula are dependent upon strictures it is probable that some of these might be greatly benefited through this procedure that could not otherwise be satisfactorily treated.

As an illustration of the difficulties and dangers attending bronchoscopy and as a contribution toward perfecting the operation and making it safer, I wish to place on record concise histories of two recent cases.

On the 14th of November, 1908, a girl 3½ years of age was brought to the hospital with symptoms of some pulmonary trouble but no history of having inhaled a foreign body, however, a radiograph showed that there was a small nail in the air passages. A surgeon did tracheotomy and attempted to remove it. He felt the nail but was unable to extract it and finally it passed down out of reach. Before the operation the pulse was 128, temperature 98 and respiration 28; 10 hours

afterward the pulse was 144, irregular and intermittent, and the temperature 104.6. The next day the pulse, temperature and respiration continued high but on the following day the pulse ranged from 128 to 160, the temperature 101 to 102.3 and respiration 60 to 72. On the succeeding day the pulse dropped to 120, the temperature to 100 and the respiration to 54. The 4th and 5th days the symptoms were better but on the 6th day (the 20th of November) it is noted that there was pneumonia of the left lung, although the temperature was not much, if any, higher. I was then asked to attempt to remove the object by bronchoscopy and at 4 p. m. on the 21st, the child was given chloroform and the operation made. A radiograph showed that the nail was at this time deep down in the left lung and the operation demonstrated that it was in the bronchus going to the upper lobe. I searched with the greatest care for about an hour examining the main stem of the left bronchus and its branches going to the lower lobe, but, probably on account of the swelling of the mucous membrane and the contraction of the bronchus, I was unable to see the opening of the bronchus going to the upper lobe and could not feel the nail. The operation was then abandoned with the intention of repeating it another day. Three hours later the pulse was 180 and weak, and the respiration over 90. At the end of 4 hours the pulse was 160, temperature 102.2 and respiration 84; 4 hours later the temperature was 103.2; the next forenoon the pulse was 160, temperature 102.6, respiration 88, but by noon, 20 hours after the operation, the pulse was 176, temperature 104.4, respiration 76. The conditions continued unfavorable and the patient died of pneumonia 48 hours after the operation.

In this case pneumonia was already present though the symptoms were not marked at the time of the operation and the bronchoscopy was done through a suppurating wound in the trachea. The patient's condition at the time of the operation and possible carrying of the pus from the wound into the lung, undoubtedly contributed to the fatal result.

How could the difficulty in seeing the bronchus going to the upper lobe of the lung have been overcome? Would it have been better to have delayed the operation until this patient had recovered, or died from the pneumonia? I await answers from others to both of these questions.

The second case—a child 17 months of age—was brought to

me on the 7th of January, 1909, with the following history: Four weeks previously the child while in perfect health was playing with an older brother and both of them fell upon the floor. The patient was immediately seized with a severe paroxysm of cough which nearly strangled it. The cough had continued ever since and there had been several paroxysms which the parents reported came near being fatal. An examination revealed a great many large and small mucous rales all over the chest, but no dullness and no disparity in the respiratory murmur on the two sides. A radiograph gave no shadow of a foreign body, but the history and signs made it practically certain that some foreign substance was in the air passages. At 4 o'clock the same afternoon chloroform was given and I operated with extreme care. I gave neither opiate nor atropin, and I used a weak solution of cocain with suprarenaline only two or three times in the larynx. The bronchoscope was introduced easily and quickly and I made a most careful and gentle search of the trachea and bronchial tubes of both sides. Owing to the great quantity of secretion the operation was much prolonged, at least 9/10ths of the time being spent in pumping and wiping out the secretions. The child was taking very little chloroform and I thought no damage was being done. I designed to abandon the operation at the end of an hour, but the condition of the patient was so favorable and my anxiety to find the foreign body so great that I unconsciously kept up the search half an hour longer, but nothing could be found.

At the time of the operation, temperature per rectum was 101° and at midnight it was 105.4°, pulse 122, respiration 140. The next noon conditions remained the same and much the same the following day, but during the afternoon of the third day after the operation the temperature and pulse fell to normal. The fourth day the temperature went once to 103°, the fifth to 100.8° and the sixth to 102.3°; afterward there was steady improvement for three or four days, but subsequently the temperature daily ranged from normal up to 2 or 3 degrees higher for four weeks. The nurse said that the child had occasional paroxysms of dyspnea during the night for three or four nights, but the bronchial rales greatly diminished, although the physical signs showed a slowly resolving pneumonia of the lower lobe of the right lung. When the temperature first went up the Interne reported a broncho-pneumonia

and I ordered 1/200 gr. of strychnia and ½ drachm of liq. amm. acet. every three hours, and the chest was covered with an oiled silk and cotton jacket. This treatment was continued until the immediate danger was passed.

How could the difficulty due to excessive secretion have been avoided? Possibly by the administration of atropin in one or two full doses for a child of this size and age.

How could the unfavorable after-results have been prevented? In this case unfavorable symptoms followed the bronchoscopy promptly and the patient certainly was near death.

Since writing the foregoing, or a month after the first bronchoscopy on this patient, after consultation with several of my colleagues, I decided to operate again. The extreme dullness over the lower lobe of the right lung, with absence of breath sounds—the outline of the dullness and the negative results of three exploratory punctures—suggested obstruction of the bronchus going to that portion of the lung with collapse and eliminated the diagnosis of pleurisy. The patient's temperature had been running up to 102° or 103° F. about every third day for two or three weeks, which pointed strongly to sepsis. At 4 p. m. February 8th, when the patient was sent to the operating room, rectal temperature was 102.7° F. Morph. sulph. gr. 1/50 and atropin sulph. 1/500 gr. had been given hypodermically—chloroform narcosis—bronchi of right lung thoroughly explored down to a caliber of 3 mm. with negative results. Examination lasted 15 minutes. Patient removed to ward and temperature found to be more than a degree lower. Patient placed in croup tent, air of which was kept very warm and moist, for forty-eight hours. By midnight the temperature was normal and the next day it was only 99.2° and patient was in excellent condition. The danger in this case seems to have been avoided by the short operation and the warm, moist atmosphere.

I incline to the belief that unfavorable symptoms after bronchoscopy are largely due to the mechanical irritation of the instrument. As I have already pointed out, the bronchi and the trachea in young children expand and contract greatly with each respiration, and (as I clearly demonstrated in a child 5½ years of age from whose right lung I removed a baby's beauty pin on Jan. 13th, 1909) the bronchi are lifted and depressed fully a centimeter with each respiratory movement.

From these movements there is constant respiratory stretching and pulling of the air tube over the end of the bronchoscope, which would cause much of the mechanical irritation. This mucous membrane is not intended to bear anything like as much mechanical irritation as the conjunctiva, therefore, it seems natural that the mere presence of the bronchoscope even without pressure and stretching of the bronchi would cause a great deal of irritation.

In order to avoid the dangers it appears to me that we must make the operation as short as possible; we must not touch any part of the tracheo-bronchial tract that can be avoided, and we should use an instrument as small as will give sufficient illumination and allow of the use of suitable instruments. The Killian tubes 6-7 mm. in diameter for children over a year of age and 7-9 mm. for adults appear to me the best. Foreign bodies in the lower part of the trachea might often be removed with a bronchoscope that only passed 1 or 2 cm. below the glottis, and foreign bodies in the bronchi may frequently be removed without passing the bronchoscope more than 5 to 10 mm. into the bronchus, providing we use a forcep that will not catch the mucous membrane on the walls of the air passages, and providing also that we are careful to open the blades in such a direction that we would not catch the tissues at the point of division of the air tube. In the trachea there would be no danger if the blades opened antero-posteriorly, for then they could not grasp the septum that runs antero-posteriorly between the two main bronchi at the bifurcation, and in the main bronchi it would be safe if the blades opened along a plane running from before downward and backward at an angle of about 20 degrees to the mesian anterior-posterior plane of the thorax, for they could not catch the tissues between the main bronchus and its first branch. Again, by using such a forceps in this way the foreign body could often be safely and quickly removed from a main bronchus without taking time to remove the secretions, so as to actually see the foreign body. Before the days of bronchoscopy I several times removed foreign bodies from the main bronchi with a bent tube forceps inserted through a tracheal opening. In the case just referred to, by upper bronchoscopy, I removed the pin quickly in this way without cleaning out the secretions after having searched for it about 7½ minutes. The whole operation requiring but 8½ minutes. There were no unfavorable symp-

toms afterward. The difficulties of esophagoscopy are slight, as compared with bronchoscopy, but one must remember that the swollen and edematous mucous membrane may roll over and completely hide quite large foreign bodies even though the instrument may pass without obstruction to the stomach. The dangers of esophagoscopy are much less, because the mucous membrane is designed for the passage of foreign bodies and therefore will not be much irritated by the instrument.

IX.

THE INDICATIONS FOR THE RADICAL MASTOID OPERATION, BASED UPON PATHOLOGIC LESIONS.*

By S. J. Kopetzky, M. D.,

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It would hardly seem to be necessary at this late day to discuss the indications for the radical mastoid operation before a body of otologists. An operation suggested upon rational, pathologic research, as early as 1873, should, by this time, have won its proper place in otology. After 36 years, it is expected that the object to be gained by this procedure, and the conditions which can properly be submitted to operation, should have been so definitely known, that they would not require of us to-day the time and thought necessary for their discussion.

However, the status of the operation is unsettled, and the reasons for this are not hard to find.

The operation gives apparently variable results even at the hands of the most experienced. Otologists, as a whole, have expected more from the procedure than scientific inquiry into its merits warrants. The indications for the employment of the radical operation have usually been based upon symptoms rather than upon an actual diagnosis of disease. Confusion naturally ensued, and the results obtained when employing the operation to cure a symptom caused us to overlook the results of the operation when computed on the basis of cures for a given disease.

A glance through the literature demonstrates that we have rather promiscuously submitted cases of otitis media purulenta chronica, with or without accompanying mastoiditis, to this operation, because after a fair and reasonable

*Read before the Eastern Section of the American Rhinological, Laryngological and Otological Society, Philadelphia, January 9, 1909.

time, with the best available therapeutics at command, we were unable to stop the persistent otorrhea, or we operated radically in these cases because acute exacerbations or intracranial or labyrinthine complications were threatening.

Excepting the symptoms in the complicating lesions, the prominent determining symptom—the otorrhea—is a common factor to many varying pathologic lesions within the middle ear and adjacent structures; and as such is not to be held as an indication for the radical mastoid operation.

A tentative classification of the pathologic lesions present in the middle ear and mastoid process, gives definite data from which so to limit the indications for the radical mastoid operation that more uniform results, under similar conditions, are obtainable.

Another element tending toward the uncertainty with which the radical mastoid operation is regarded, is to be found in the fact that we do not all perform the same operation for the same given pathologic lesions. We do not all perform a complete radical mastoid operation.

The Stacke operation is the selected procedure of many; the Zaufal operation—often designated in this country, the Schwartze-Stacke operation—has the majority of adherents, and, finally, a few—Heath, Bryant and Ballenger and their followers—have recently advocated a so-called modified radical operation, in which the ossicles are retained, and the membrana tympani preserved, in the interest of the hearing faculty.

Here again, confusion is averted, if the results obtained from these varying procedures are classified and judged separately.

The Stacke operation differs really but in slight degree from the Zaufal operation. It is rather a different route toward the same end. When we add to the Stacke method, complete evisceration of the mastoid contents, the end results of both operations are the same. A true Stacke operation limiting the surgery to the uncapping of the antrum after opening and connecting this with the tympanic cavity, and only removing the adjacent bone of the mastoid process, necessarily must only be indicated by a rather localized pathologic process.

When, however, the area of disease is extensive, i. e., if it is found spread beyond the confines of the tympanic

and the antral cavities, a removal of more tissue is indicated than the limits of the operative endeavor as laid down by Stacke.

Since no surgeon would stop his procedure before entirely eradicating all removable areas of disease, we hold the Stacke operation as now practiced to be a difference in technic rather than a separate operation from that of Zaufal (the Schwartze-Stacke), and we may consider the indications for both these operations together.

By the radical mastoid operation is meant a procedure which shall cleanse the tympanic cavity of all its diseased mucous membrane, in all its accessible and removable parts; which shall eradicate the cellular structure about the orifice of the Eustachian tube; which shall remove the two major ossicles and the remains of the membrana tympani; which shall open the mastoid antrum, connecting it with the tympanic cavity by as wide a passage as possible, thereby freeing the aditus ad antrum, eviscerating the diseased contents of these cavities, and finally removing as much of their respective bony walls as are found diseased and are capable of removal, and in addition removing from the mastoid process and temporal pyramid as much of its bony structure and its contents as is found diseased. To these procedures there is added a plastic. Such an operation meets the indications for radical mastoid surgery.

The operation devised by Heath, the one advocated by Bryant, and the so-called meato-mastoid operation of Ballenger, can hardly be held to constitute a radical mastoid operation at all. At another section of this Society, I shall discuss these operations in detail. Suffice it here to call attention to the fact that in the lesions of the middle ear and its adnexa, which are chronic in nature, and where there has existed a purulent, fetid otorrhea, coming through a more or less pronounced perforation or defect situated marginally in the drum, that with lesions producing these findings, there is usually bone necrosis in the neighboring parts—the aditus and the tympanic walls—especially the posterior tympanic wall. No operation devised to remove other parts, and yet preserve intact the original seat of the lesion is, surgically speaking, logical. Neither can the preservation of more or less diseased ossicles and the remains of a drum membrane whose final healing means the ad-

vent of considerable scar tissue give much toward the conservation of the hearing faculty. To find proof of this contention, we have only to call to mind the demonstrable loss of hearing in those cases of chronic otitis media purulenta, which we healed by local measures, where, after a lapse of time, the scar tissue became firmly contracted.

Either the entire principle under which otology has accepted ossiculectomy is an error, or what seems more likely from a study of the greater number of the cases submitted to this modified radical operation, Heath, Bryant and Ballenger, especially the two former—since Ballenger separates his indications for the meato-mastoid operation from those he lists for the radical—have thus operated upon cases which would have responded to a simple mastoidectomy, with results as brilliant regarding the hearing faculty, as these men report having obtained from the involved technic of the so-called modified radical operation. For the present, we can therefore leave out of account this operation in discussing the indications for radical mastoid surgery.

Otitis media purulenta chronica is a generic, clinical term. It implies a diseased ear with a persistent purulent discharge. Both from the standpoint of a consideration of the indications for the radical operation and for an estimation of the results of the procedure, so general a term as this can have no place in a list of conditions indicating a surgical procedure.

The actual pathologic lesions grouped under this term are: (See Chart, appended herewith.)

1. Caries of the ossicles accompanied or not by a suppurative inflammation of the mucous membrane lining the tympanic cavity and adnexa.
2. Chronic suppurative inflammation of the mucous membrane lining the tympanic and the adjacent cavities, including the Eustachian tube, especially at its orifice, without there being any disease present in the underlying bone at any point.
3. Caries of portions of the temporal pyramid (non-tubercular and non-syphilitic in nature) accompanied by a suppurative inflammation of the mucous membrane lining the middle ear cavities.
4. Necrosis of greater or lesser portions of the bony

walls of the middle ear spaces and mastoid process, with destruction of large areas of mucous membrane lining the tympanic and adjacent cavities, and exudative inflammation in the remaining sections of the mucosa of the middle ear spaces.

5. The erosive lesions, pressure necroses in various parts of the middle ear, caused by the ingrowth of psuedo—and true cholesteatomata or other malignant growths; part of the clinical picture being caused by the disintegration of the cholesteatomatous or other new-growth masses, in addition to the pus caused by the bone necrosis.

6. The specific lesions of parts of the temporal bone, especially when found to involve the middle ear spaces and mastoid process: that is, the tubercular and syphilitic lesions.

It is not within the scope of this paper to take up the details of the differential diagnosis between these groups of cases.

These six groups of cases all present ears evidencing all or part of the following: A persistent discharge, usually fetid, coming through a perforation in the membrana tympani, of varying size and location, and often, in addition, presenting the presence of polyps or polypoid granulations on the visible portions of the mucous membrane, or inflammatory excrescences sprouting through the perforation.

The radical mastoid operation is not indicated in isolated caries of the two greater ossicles. This condition is rare, and on the whole, the removal of the diseased ossicles and the establishment of intratympanic drainage will suffice to cure these cases. When ossicular caries is accompanied by an exudative inflammation of the lining membrane of the tympanic cavity—a product of the irritation locally by the dead ossicles, plus insufficient drainage, or the result of disease in the nasopharynx which has spread by contiguity through the Eustachian tube, there also the radical mastoid operation is not immediately indicated. If after ossiculectomy and the proper treatment of the nasopharynx, large quantities of pus continue to emanate from the anterior wall of the tympanic cavity, or seem to come away from the upper chambers of the tympanic cavity, from the aditus especially, then radical mastoid surgery is indicated

to remove detritus, lay open the disease-containing cavities, and render these accessible to subsequent after-treatment.

In cases where the mucous membrane lining the tympanic cavity and its adjacent structures is the seat of a chronic exudative inflammation, and there is no lesion present in the underlying bone, the pathologic process present in the mucous membrane is the product of the spread by contiguity of an exudative process in the nasopharynx and Eustachian tube. Removal of the primary foci and the performance of ossiculectomy may stop the exudative inflammation, and thus cause a cessation of the otorrhea. When the disease is of long standing and has thoroughly blocked the Eustachian tube by inflammatory exudate, and when the continuance of the process in the middle ear, by developing plastic inflammatory adhesions about the stapes and at the niches of the labyrinthine windows, threaten a gradual but progressive loss of hearing, then it would seem better in the interest of the patient's hearing and the prevention of a superimposition of an acute exacerbation, to clean out the middle ear spaces thoroughly, especially curetting the orifice of the Eustachian tube, and removing diseased mucous membrane, thus rendering the middle ear spaces in toto accessible to further local after-treatment.

In both the above groups of cases, which in a recent monograph,* I designated as of the nondangerous type of otitis media purulenta chronica, the disease may go on indefinitely without threatening intracranial involvement. This class of cases is, however, often subject to acute exacerbations, resulting in acute mastoiditis superimposed on the chronic disease of the mucous membrane of the middle ear. A simple mastoidectomy to relieve the acute symptoms will sometimes suffice in this particular class of cases, although I prefer the radical procedure for the reasons already given.

Radical operation is often demanded in the group of cases under discussion, because of the progressive loss of hearing which these cases evidence. The radical mastoid, by removing the major part of the diseased mucous membrane, eventually causes the suppuration to stop, because the instituted after-treatment permits a logical, rational

*The Surgery of the Ear. Rebman Company, New York.

therapeusis to be applied to the remains of the diseased tissue necessarily left in situ. The radical operation, even in its most extensive limits, is unable to effect a complete evisceration of the mucous membrane lining the middle ear spaces, and there generally remain portions of diseased tissue about the labyrinthine windows and in the more inaccessible parts of the Eustachian tube. Here then is a group of cases wherein the radical operation, although indicated as a step toward its cure, will not stop the otorrhea. The discharge from such ears only ceases when these remains of mucous membrane either become converted into epidermis, or become healed because their entire surroundings are healthy. Regarding the hearing in this group of cases, it is generally found slightly worse after the operation than before, provided the operative procedures have not been delayed too long in the course of the disease, but it is vastly better than it would be were the suppurative inflammation to be allowed to continue for years unchecked.

In necrosis of part or all of the bony tympanic walls, in caries located in the various parts of the temporal bone, mastoid process, sections of the petrosa, etc.; in pressure necrosis due to epithelial ingrowths from cholesteatoma, and in the syphilitic and the tubercular lesions of the mastoid process and petrosal pyramid, whether accompanied or not by a syphilitic or tubercular involvement of the tympanic cavity, the radical mastoid operation is indicated.

In ordinary bone necrosis, more or less localized in area, with or without sequestra formations, and in cases with cholesteatoma and tuberculosis of the mastoid process, the radical mastoid operation gives the most satisfactory results, although in cases with cholesteatoma, supervision is afterwards necessary to prevent recurrences. The predominating symptom—the otorrhea—is usually stopped as soon as the lesion is eradicated. In syphilitic lesions, I have often been unable to secure healing, because I could not secure proper epidermatization, although, generally speaking of these cases as a class, the results obtained warrant me in classing these lesions as indicating a radical mastoid operation.

When symptoms referable to intracranial involvement, or intralabyrinthine disease become evident, or when symptoms demonstrate an acute process superimposed upon

any of the pathologic lesions constituting otitis media purulenta chronica, then the complete radical mastoid operation is immediately indicated.

Summarizing, we contend:

1. That the various diseases for which the radical mastoid operation is indicated should be classified and studied according to their pathologic aspect.

2. That the cessation of otorrhea is not the only condition for which the radical mastoid operation is indicated.

3. That the radical mastoid operation does not stop the otorrhea in a certain definite group of cases, but the operation is eventually indicated in these cases, notwithstanding failure to check this one symptom. In these cases, the operation is but one step toward their final cure.

4. That in bone lesions, located both in and beyond the tympanic cavity, the radical mastoid operation is the only procedure which is indicated by the pathologic lesions present in the mastoid process, temporal pyramid or tympanic walls. That the removal of the diseased bone cures the suppurating ear, and the result in these cases is proportionate to the thoroughness with which the lesion is eradicated.

5. Finally, that the so-called modified radical operation does not meet the indications for radical mastoid surgery.

Group.		Otoscopic Picture.	Lesion.	Complicating Lesions.	Operations Indicated.
Otitis Media Purulenta Chronica.	A.—Non-dangerous type.	Centrally located perforations.	Suppurative inflammation in Eustachian tube pharynx and mucous membrane of middle ear spaces.	Acute mastoiditis.	Surgery to nasopharynx, ossiculectomy and eventually radical mastoid operation. Occasionally, simple mastoidectomy suffices.
	B.—Dangerous type.	Perforations located at margin of membrana tympani.	Bone involved in middle ear, mastoid process or petrosal pyramid. Necrosis, caries, cholesteatoma, new growths, tuberculous or syphilitic processes in the bony structure.	Acute mastoiditis, intralabyrinthine or intracranial lesions, and any local intratympanic lesion causing facial palsy.	Radical mastoid operation as soon as diagnosis of bone lesion is made.

X.

A SERIES OF PAPERS ON SINUS DISEASE.

First Paper.

Report of a Case of Cyst of the Frontal Sinus, Communicating With the Frontal Lobe.*

By Clement F. Theisen, M. D.,

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The following case, because of the apparent rarity of one feature of it, was considered of sufficient interest to be reported:

Cysts of the frontal sinus, particularly mucoceles, are not so very rare, but it is fairly uncommon to find an absence of a large part of the posterior or cerebral wall of the sinus.

The patient, Miss M. B., aged thirty-four years, consulted the writer July 27, 1907. The only interesting point in her history is a severe fall, striking her head, when she was nine years old. She stated that she was unconscious for three days at that time. From that time she has been a sufferer from severe headaches, more intense on the left side. She is a worker in a textile mill.

In 1905 she had a nasal operation, the exact nature of which she could not tell me. This gave her some relief. For a number of years she had had a discharge from the left nostril. This, she believed, followed some work on the teeth on that side. About a year before consulting the writer her left maxillary antrum had been opened through the canine fossa, and for a time she thought she was a little better.

Her physician, Dr. J. B. Ledlie, of Saratoga, who referred Miss B. to me, told me that since July, 1907, her headaches had been unusually severe, particularly on the

*Read at the thirtieth annual meeting of the American Laryngological Association, at Montreal, May 11, 12 and 13, 1908.

left side. She also complained of a pressure and fulness over the eyes. There was slight ptosis of the left eyelid, but no orbital swelling nor displacement of the eyeball. When she turned her head quickly to the left, or bent forward suddenly, she had great vertigo, and would fall if she could not get hold of some support. Pupils reacted to light and accommodation.

On examination nothing particularly wrong could be discovered in the nose. There was a small amount of a thin, mucopurulent secretion in the left nostril, which came from the antrum. On transillumination the left antral region was slightly darker than the right, but there was good illumination of both, and the pupils were also illuminated.

The left frontal region was darker than the right. This region was also slightly more prominent.

The headaches were becoming so frequent and severe that she was anxious to have any operation that would relieve her. While there was no direct evidence of a purulent frontal sinusitis, the result of transillumination, with the headaches confined to that side, appeared to the writer sufficiently suspicious symptoms to warrant an operation. This was performed in the Saratoga Hospital in August, 1907. The usual incision through the eyebrow was made and a portion of the anterior wall of the sinus carefully removed. A fluctuating tumor, having the typical appearance of a cyst, presented in the opening. It appeared to contain considerable fluid. An incision was made through the cyst wall and a large amount of a fluid very much like thin mucus escaped. This was, unfortunately, lost, so that no examination could be made of it. The anterior wall, as well as the floor of the sinus, was found intact, but a considerable portion of the posterior wall was missing, so that the pulsation of the meningeal vessels could be seen. The cyst wall, in fact, appeared to extend through to the frontal lobe.

The sinus was large and somewhat dilated.

The anterior ethmoid cells were then investigated through a separate incision, following the method employed by Coakley. No pus and very little bone necrosis was found. At this time the patient went into a condition of collapse, and it was with great difficulty that we succeeded in reviving her. We could not get a probe through into

the nose from the frontal sinus, so that, as in cases of mucocele, the ostium was probably occluded. As much of the cyst wall as possible was removed, and the frontal wound, with the exception of a small opening in the inner angle, closed. A small wick of gauze was carried into the sinus for drainage, but in about ten days the gauze was no longer inserted and the wound allowed to close. The patient made an uninterrupted recovery, and now, about ten months after the operation, is apparently perfectly well. She works twelve to fourteen hours a day and has no headaches.

I received a letter from her physician, Dr. Ledlie, a week ago, in which he stated that she was all right and able to do her work every day.

A. Logan Turner, in his interesting paper on mucocele of the accessory nasal sinuses, reports two cases in which, as in the writer's case, absorption of part of the posterior wall of the sinus had taken place.

In six out of seven cases reported by him absorption of a part or the whole floor of the sinus had taken place.

I will briefly report the two cases in which part of the posterior wall was missing.

Case 1.—C. S., a woman, aged forty-three years. During the operation it was found that a portion of the posterior, or cerebral, wall the size of a half-crown had been absorbed, so that the dura mater was seen pulsating.

Six months after the operation there was no discharge from the cavity. A drainage tube was carried into the nose at the time of the operation and worn for six weeks. It was then removed, and the patient was instructed to wash out the sinus with a curved canula.

In the second case reported by Turner, a woman aged thirty-seven years, the dura was found exposed over an area as large as a sixpence. The right eye-ball was displaced downward, outward and forward. This was so in the other case also.

In the writer's case there was no orbital swelling, a common symptom of cyst of the frontal sinus. The anterior ethmoid cells are frequently involved. Patients, as a rule, do not complain of much pain unless infection of the sinus takes place.

In Turner's cases there was displacement of the eye-ball in seven out of ten.

The displacement depends upon the size of the orbital swelling. Turner states that when the affected sinus extends backwards for a considerable distance along the roof of the orbit, and the mucous contents escape into the orbital cavity after the floor has been absorbed, the eye-ball is pushed forward and downward. A previous catarrhal condition of the nasal mucous membrane is the probable cause of such cases.

The ostium of the sinus becomes occluded, causing an accumulation of mucus in the frontal sinus and a gradual thinning and absorption of one or more of the bony walls.

Killian believes that traumatism is an important cause for the development of such cysts.

The writer was able to find records of only a few other cases of cysts of the frontal sinus, in which a large portion of the posterior wall of the sinus was absent, in the literature of the past ten years.

Casali has reported the case of a man, aged forty-one years, who had had a fall, striking the right side of the head, eighteen years before consulting him. There was a fluctuating swelling above the supraorbital ridge, extending down to the middle of the upper eyelid.

There was also a right exopthalmos.

A clear, sterile fluid was obtained on puncturing.

A radical operation was performed. After the anterior cyst wall was removed the pulsation of the meningeal arteries could be seen. Two hundred ccm. of clear fluid was evacuated.

Histological examination showed that this was probably not a cyst, but an enormously dilated frontal sinus. Another interesting case has been reported by Mayer.

This patient, aged fifty-three years, had been twice operated on for a cyst of the frontal sinus.

A large amount of a yellowish fluid had been evacuated, and it was found that the posterior wall of the sinus was missing.

The patient survived the first operation, but in a year there was a recurrence, and the second operation had a fatal termination. In the region of the right frontal lobe there was a deep depression produced by the cyst.

In a case reported by Zamazal of severe left-sided headaches for two years there was a sudden flow of pus and blood from the nose just before the patient died. There was an abscess in the region of the frontal lobe which broke through into the frontal sinus.

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XI.

ANATOMY AND DISEASES OF THE STYLOID EPIPHYSIS.

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In late years, the laryngologist has found it necessary to consider many faulty embryonal developments, especially those occurring about the ear and in the roof of the mouth. Pathologic conditions resulting from normal embryonal anlage of the mouth and throat are infrequent, yet of sufficient interest to warrant a most careful study of the subject. These conditions have more often come within the field of the general surgeon and for that reason, have probably been neglected by the rhinologist and laryngologist.

The branchial arches and clefts are the essential formations necessary to the differentiation of the head and neck structures. The pharynx is the dilated end of the cephalic primitive gut tract, and within this structure about the twenty-first day, we have a bulging outward of the ectodermic surfaces, forming pharyngeal pouches or furrows on the external surface, which are designated as visceral clefts. The visceral arches are composed of mesodermic tissue and separate the clefts and furrows from each other. About the fifth week of fetal life, obliteration of the arches and clefts begins by the permanent formation of the head and neck structures. Some of the arches undergo absorption, and we have to deal in this paper with the imperfect absorption.

The visceral arches are five in number. The first has to do with the formation of the upper and lower maxillary bones, mouth cavity, malleus and incus. The second visceral arch, the one especially under discussion, becomes

obliterated with the exception of a bar of cartilage, designated Reichert's cartilage.

At its uppermost portion, Reichert's cartilage becomes the stapes, and the lower portion subdivides into segments, denominated by Geoffrey Saint-Hilaire as the tympanohyal, stylohyal, and epihyal. The tympanohyal is the base of the process, articulates with the temporal bone, is immediately attached to the inner surface of the tympanic plate, and appears externally to be wedged between the tympanic plate and the petrosa, anterior to the stylomastoid foramen. The stylohyal forms the styloid process proper and the epihyal as a rule remains fibrinous and becomes the styloid ligament. The petrostyloid articulation is fibro-cartilaginous or a synarthrosis, and thus may admit of some motion.

Dr. Dieulafe (L'Echo Medical, July 20, 1901) reports such a movable styloid and refers to Cruveilheir, who says such a condition is not very rare.

Mr. Porter (Reports of the Dublin Pathological Society, February, 1873) reports three cases of abnormal styloid process, very slender and flexible, and attached to the temporal bone by cartilage, possessing no styloid muscle and ligament.

Von Thaden (Deutsche Zeitschrift für Chirurgie, 1874-5) also reports one case in which the joint was slightly movable.

From these observations, it may be concluded that a movable articulation is not uncommon, and with such a condition existing, the whole process may be deflected towards the fauces and become, under favorable conditions, a source of annoyance, as we shall show later on.

The epihyal becomes normaly the stylohyoid ligament and articulates with the ceratohyal, which becomes the lesser cornu of the hyoid bone, The epihyal instead of changing into the stylohyoid ligament, may become osseous in structure and be firmly united to the hyoid bone or the process proper may develop to such an extent that only a few fibers of the ligament remain. The process may also be firmly united to the hyoid bone by bony union. The styloid process becomes completely ossified between the twentieth and thirtieth year.

It is interesting to consider the influence of the variation in the length of the styloid process upon the voice. The

length of the styloid process varies in individuals and as long as the process is directed downward and parallel with the carotid artery, probably no trouble other than disease of the bone may be expected; however, if the process is deflected inward, from its natural development or from traumatism, more or less voice affection and irritation in the throat may occur.

According to Gruber, the normal length of the styloid process is about one and one-quarter inches. The styloid process was observed to be two inches long by Hildebrandt, Meckel, Cruveilhier and Humphrey, and in the old museum at Wilna, Winslow observed one process three inches long. Gruber examined over two thousand skulls and in this number found one specimen with a styloid three inches long, eleven were nearly two inches, and the remainder were near the normal.

Interesting as the study of the styloid process may be, it is of special importance to the laryngologist because of the pathologic sequences which have their origin in, or are the sequelae of, the process. For convenience, and because heretofore no classification has appeared, as far as I know, diseases of the styloid process may be divided into the following classes:

1. Inflammation.
2. Necrosis.
3. Deflection (producing obstruction in swallowing and disturbance in speech).
4. Fracture.
5. Exostosis.

INFLAMMATION AND NECROSIS.

von Thaden reports the case of a woman thirty-five years of age, who suddenly and without any apparent cause, was attacked with pain in the right ear and tinnitus aurium, followed in a few hours by swelling in the retromaxillary region of the affected side, extending into the cheek and neck, causing almost impossibility of swallowing. On the eighth day an abcess ruptured into the oral cavity and discharged a quantity of foul smelling pus. A week later the pus reaccumulated and an incision five centimeters long, following the sternocleidomastoid muscle, was made, evacuating pus and decayed cellular tissue. Examination

showed the pus cavity to extend to, and surround, the styloid process, which was roughened and covered with softened tissue. Recovery followed with the exception of a partial facial paralysis, which followed the onset of the infection.

DEFLECTION.

Because the articulation with the temporal bone may be bony or fibrinous, deflection of the styloid process may occur from natural development, or it may occur from traumatism, due to fracture or injury to the neck from a fall or blow. Deflection of the process is of more especial interest because it is a condition which is probably more often observed than inflammation or necrosis. In many cases this condition is only observed following the removal of the tonsils. Physicians report observations of a bony pointed growth in the supratonsillar region after the removal of the tonsils, and also particles of bone removed at the time of the operation or in the tonsillar structure, without associating the bony structure with the styloid process. Since conditions of this character may occur, it would probably be wise to palpate the tonsils before attempting their removal, not alone for the detection of a deflected styloid process, but for abnormal pulsations in the tonsil or pharynx.

In the differentiation of hard immovable bodies in the lateral wall of the pharynx, Wyatt Wingrave (British Medical Journal, 1900) says, "The existence of the subpharyngeal cartilage of Luschka seems to have been overlooked. This structure is by no means rare, and from the frequency of its occurrence I am inclined to think that this body was probably mistaken for a displaced styloid process. The cartilage occurs not only in the lateral wall of the oropharynx, somewhat behind and below the faucial tonsil, but also in the tonsil itself, which I have often verified by microscopic examination, attention having been drawn to it by experiencing an exceptional resistance to the guillotine. It consists of hyaline cartilage embedded in a capsule of white fibrous tissue, and is supposed to be a vestige of the third post-oral arch."

The results of a deflected styloid process from fracture, abnormal elongation, or twisting from traumatism, may be

obstruction in swallowing, painful deglutition, disturbances in voice, sensation of a tumor in the tonsillar region, and the presence of a hardened, blunt-pointed object, which is detected upon compression of the tonsil or the surrounding tonsillar region. The symptoms enumerated are usually progressive in character and are confined to one side.

Rethi of Vienna (Internationale klinische Rundschau, 1888) reports two cases observed by Professor Weinlechner, with the general symptoms as enumerated. In one instance, Dr. Weinlechner made compression with his finger inserted in the mouth, sufficient to fracture the process, when all symptoms disappeared. However, after nine months the irritation in the throat returned. By making compression again, the process was fractured in two places and the symptoms disappeared entirely.

In the second case, patient age forty-six years, Professor Weinlechner reported that at the lower end of the left tonsil and near the palatoglossus muscle, a hard knob was felt, which was painful to the touch. He tried to fracture the bone, but did not succeed, all symptoms remaining.

Rethi reports his own case: a man of twenty-eight years began to have progressive irritation in the left tonsil, producing great pain and distress in deglutition and necessitating medical assistance. The styloid process was removed by splitting the tonsil, followed by relief of the symptoms.

In my own case, a physician of thirty years, a veteran of the Spanish-American war, in his personal report of the case said that on September 30, 1907, he was thrown from a wagon, striking his head and shoulders and fracturing the first and second metacarpal bones of the left hand. His neck was very stiff and painful for a couple of weeks. On December 1, 1907, he began to suffer from hoarseness in the afternoon and evening, with little or no hoarseness in the morning. This condition continued until the latter part of December, when he could hardly speak above a whisper. There was no pain present. During the months of January and February following, there was nearly complete aphonia. He took mineral baths for the condition and while engaged in this treatment, discovered that the left tonsil was enlarged, with a hard growth immediately beneath it. The tonsil and growth were cauterized and the aphonia was partially relieved until April, when it again appeared. There

began now a sensation of constriction in the throat when speaking or singing. The singing voice was almost lost. The growth beneath the tonsil was now so prominent that by depressing the tongue he could readily see it. Pressure upon the growth caused pain and irritation.

On June 24th, 1908, I examined this patient. A distinct mass with small blunt point could be seen beneath the tonsil, and by palpation I could readily outline the hardened bone, external and posterior to the tonsil. X-ray photograph gave us the accompanying picture, which distinctly shows two elongated styloid processes with a large exostosis on the one, presumably the left, due, we think, to the fracture of the process, which, from the history of the case, one is justified in concluding occurred at the time of the alleged injury, producing the symptoms enumerated.

Under local anesthesia, the tip of the process was first exposed, in doing which the inferior aspect of the tonsil was loosened, and the tonsil entirely removed, leaving the process exposed. Reflecting the anterior pillar and with a narrow ringed tongue depressor, the process was encircled and the tissues lifted as far as possible from the process without injuring the surrounding structures, and with a bone forceps, the process was severed. The portion removed measured one and one-quarter inches in length. The patient made an uninterrupted though slow recovery.

FRACTURE AND EXOSTOSIS.

From the foregoing enumeration of cases, it is readily perceptible that fracture may occur from any traumatism, and if the process is deflected, serious consequences may follow. With a history of traumatism of the head and neck, followed by throat symptoms, we should always take into consideration the possibility of injury to the styloid process and its influence upon these symptoms.

Exostosis and neoplasms of the process, though infrequent, may likewise be encountered and may be mistaken for disease of the neighboring lymph glands. Surrounded as the styloid process is by tissue susceptible to infection, it is reasonable to presume that the process is more often involved that we may now suspect. Abscesses designated now as peritonsillar or quinsy, in which foul pus is evac-

uated, should be looked upon with suspicion as having their origin in or about the styloid process.

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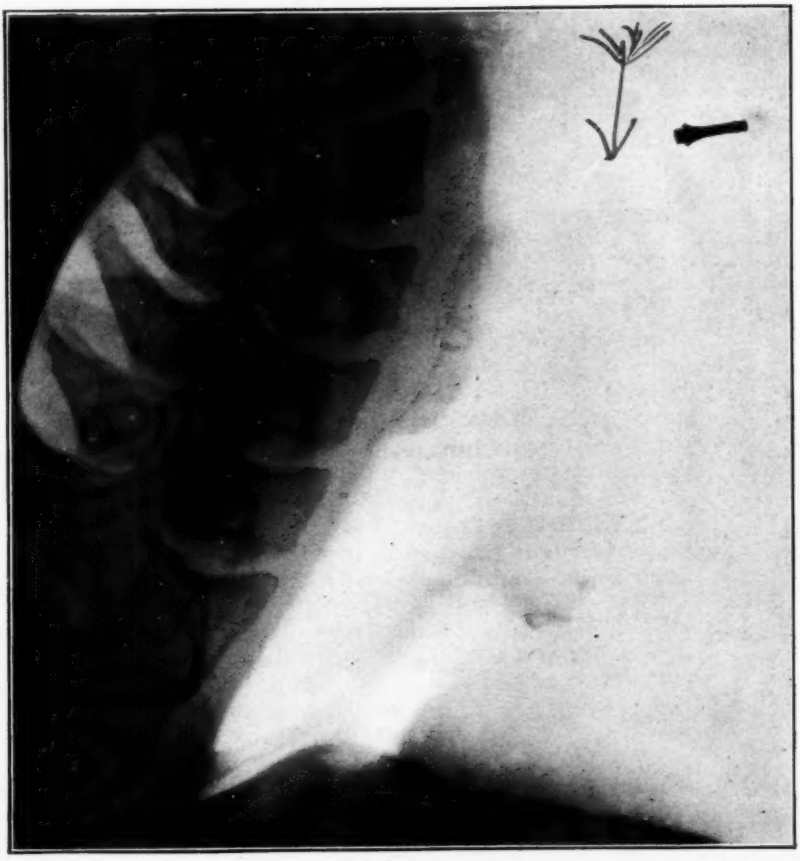

XII.

CASE OF DOUBLE MASTOIDITIS FOLLOWED BY LEFT SIGMOID SINUS AND JUGULAR VEIN THROMBOSIS. OPERATION. RECOVERY.

By John F. Barnhill, M. D.,

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Francis D——, age 16, Vincennes, Ind., was brought to the Deaconess Hospital by her family physician, Dr. Jones, February 26, 1908. A night trip had been made in order to reach the hospital early, the patient's condition being one of emergency. The history of the case was, briefly, as follows: The young lady had suffered from a severe attack of measles five weeks ago, at which time both ears discharged. In three weeks she had so far recovered from the measles that she was able to sit up a part of each day, and Dr. Jones had believed it unnecessary to continue his visits. On February 24, two days preceding the date of the patient's entering the hospital, the doctor was called on account of rigors, high temperature, double vision, fainting on attempts to rise up in bed, and especially on account of the rather profound deafness and unbearable pain in the region of both mastoid processes. The temperature was at this time 104° F., the pulse rapid and weak, there was exquisite tenderness over both mastoids and both ears were discharging very profusely. Mastoid surgery was advised and the patient was hurried to the hospital.

I saw the case at 8:00 a. m. February 26, and found conditions as above stated. The temperature remained at 104° F., the mastoid tenderness being still very acute, the discharge from the ears very profuse, the diplopia marked and the prostration very great. A double mastoid operation was advised just as soon as the patient could be prop-

erly prepared, and at 1:00 p. m. the same day both mastoids were thoroughly cleaned out and free communication was established between the mastoid wound and middle ears of each side for the purpose of securing free drainage from every infected cavity. The entire operation lasted only 50 minutes. The patient took the ether rather badly, and at the conclusion was weak and much cyanosed, on which account oxygen was administered by inhalation. The cellular structure of the left mastoid contained pus everywhere, whereas the osseous structures of the right contained but a few drops but were found much softened, and on the whole it was a question as to which was most diseased.

The temperature at 5:00 p. m. was 99.4° F., pulse 70 and general condition good. It was at that time believed that the foci of infection had been entirely removed and that rapid recovery might be reasonably expected. The temperature remained below 101 until noon February 25, when it was 102.4° F., and at 1:00 p. m. it was 104.2°. Chilly sensations were recorded as preceding the last temperature rise. Phenacetine was ordered in gr. iii doses, and, when the temperature should subside to 102°, gr. x of quinin sulphate in three doses one-half hour apart.

For the next week the temperature ranged between 99 and 104. March 2, 3 and 4 the temperature did not exceed 101.4, the general condition was good, the mastoid wounds were healing rapidly and a careful analysis of the situation indicated the convalescent stage. March 5, however, the temperature again rose to 104, and on March 7 to 105.5. Operation for the relief of sinus thrombosis was performed March 8.

Subsequent to the mastoid operation the patient complained of absolutely no pain, the mentality was at all times acute, and several times during my visit she would recite off-hand verses of poetry which she seemed to compose on the spur of the moment, and which had both sense and melody in them. At no time did any symtoms other than the septic curve of the temperature and the slight chilly sensations point to sinus thrombosis. Such a complication was, however, suspected from the first, but since the mastoid tissues of each side had been equally septic, and each had been thoroughly exenterated it seemed impossible to determine which sinus, and which side, might

be causing the trouble. Malaria was considered and quinia administered in large doses without effect. The abdomen was at first distended and tender, and typhoid fever or appendicitis was thought of but at once eliminated. On the fifth day after the mastoid operation a blood examination showed

Hemoglobin 65
Red cells 3,360,000
Leukocytes 18,000

Differential count:
Polymorphoneuclear 80%
Lymphocytes 20%

No examination of the eyegrounds were at any time made. Except on the day of admission to the hospital, when diplopia was present, no complaint whatever was made of any eye difficulty.

At the time of the operation for sinus thrombosis the left side was chosen for the rather illy defined belief that this was the worse of the two. The old mastoid wound was curetted and as thoroughly cleansed as it was possible to do. The soft structures were incised to the bone backwardly from the line of old incision, and the skull was thus laid bare over a large area by the reflection of a superior and an inferior flap. With mallet and gauge the sigmoid sinus was widely exposed toward both the torcular and jugular ends. The vessel had an almost normal appearance, and felt soft and healthy to the touch. It was incised for a distance of almost two inches, the upper end being filled with a firm coagulum, while the jugular end contained creamy pus. In order to avoid carrying this septic material to parts of the vessel which contained flowing blood, all of the exposed contents of the sinus were removed before efforts at curettage of either the upper or lower ends were attempted. The clot was easily dislodged from the torcular end by means of the curette, but no fluid blood could be secured from the direction of the jugular bulb. The mastoid wound was therefore packed with gauze, the instruments and hands sterilized, and the internal jugular vein was exposed from the entrance of the thyroid vein upward. It was found thrombosed from the entrance of the facial vein upward, and hence was ligated below the

facial and completely resected above as far as possible. A small cigarette drain was inserted the full length of the neck-wound, the whole extent of which was immediately sutured except the point of exit of the drain. The temperature became normal in three days, the neck-wound healed by first intention and the cavity into the mastoid and sinus was completely filled in four weeks.

There were three interesting points connected with this case: (1) It was decidedly atypical, since there was never a pronounced chill, no sweating and no pain except that due to the mastoiditis. The only prominent symptom present after the mastoid operation was the septic temperature. (2) The appearance and feel of the sigmoid and lateral sinuses were almost normal, although when extensively incised they were entirely filled with clot and pus. (3) Owing to the fact that both mastoids were about equally involved it was difficult to state with certainty on which side of the head the thrombosis existed, and this point was of course not definitely settled until the sinus was uncovered and incised.

XIII.

OBSTRUCTED NASAL RESPIRATION AND ITS RELATION TO DENTAL DEFORMITIES.*

By John Howard Allen, M. D.,

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A consideration of the influence upon the teeth of factors external to the mouth, brings to the attention the constantly widening scope of modern denistry; and while I do not feel competent, nor is this the occasion, to consider such a subject, I hope I may be pardoned if I preface this discussion of the relation of impaired nasal respiration to the dental structures with a word in regard to the relation of the practice of dentistry to that of medicine. I am not sufficiently familiar with the trend of dental thought to know whether the question of an alliance of denistry with medicine is favorably regarded or not. Very likely there are many present who are able to look forward somewhat definitely to such a coalition at a not distant time. There seems to be no more reason for giving over to an independent profession the care of the mouth and teeth than for a similar disposition of the eye or ear. If the oculist needs also to be a physician, no less does the dentist. Surely the relation borne by the oral cavity to the general organism is as intimate and as important as is that of the ear or the nose, and dentistry has as much claim to be considered a specialty in the practice of medicine as has otology or ophthalmology.

No phase of the ever-broadening field of dentistry is more eloquent of the changes which are taking place in its practice, than is the development of preventive dentistry. Preventive medicine, as it is termed, has come to be recognized as the highest and worthiest branch of medical art, and with the introduction of preventive dentistry the dental

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profession allies itself with that which is best in medicine. Physician or dentist, our art is the art of healing, but more and more are we learning to add to this the science of prevention. He who by the magic of his skill transforms a decayed and torturing tooth into a sound and painless member, with years of usefulness before it, is deserving of much gratitude from his patients. But he who by wise forethought and intelligent care is able to forestall pain and prevent decay is far more a benefactor, and deserving of greater praise. It cannot be doubted, either, that the doctor of dental surgery or the doctor of medicine who seeks to guard the welfare of his patients by the prevention of disease and the anticipation of deformity will have a higher standing in the community, and will not only deserve but receive more at its hands, than he who contents himself merely with the repair of injuries.

It is with the desire of directing attention to a condition which is perhaps responsible for more dental malformations than any other that this paper is written. The influence of enlarged adenoids upon the dental structures is a subject which, while it has received some attention at the hands of the dental profession, has, it seems to me, been accorded but a very small part of the consideration which it deserves; and I wish to emphasize the importance of this condition to the dentist, and urge the necessity of its early recognition and treatment, in order that the dental deformities which so commonly follow it may be prevented.

Obstructed nasal breathing is in my opinion the prime factor in the production of a large percentage of dental malformations.

There are several secondary factors, among the more important of which may be mentioned—loss of occlusion resulting from the parted jaws of the mouth-breather, and the pressure upon the lateral alveolar processes resulting from the increase of tension of the buccal muscles which obtains when the lower jaw is dropped.

I shall try to show that a large percentage, perhaps the majority, of dental deformities, whether consisting of a narrowed V-shaped upper arch, a unilaterally flattened arch, rotated or displaced teeth, or an undershot or so-called prognathous lower jaw, are directly or indirectly the result of impaired nasal breathing. In order to appreciate this

statement we must consider the mechanism by which these changes are brought about.

HOW IMPAIRED NASAL BREATHING CAUSES DENTAL DEFORMITIES.

In the first place, we have to take into consideration an elemental anatomic condition, viz.: that the floor of the nose and the median portion of the palatal arch are composed of the same bony structures—the palate processes of the maxilla and the horizontal plates of the palate bone; and secondly, a well-established biologic truth—which is, that any organ which is not used does not properly develop. To the latter law the nasal cavity is no exception.

Interference with nasal breathing during the period of the body's growth necessarily inhibits the development of the nasal structures. Through impairment of function the organ fails to expand, and in a mouth-breathing child of twelve the intranasal dimensions may be but little greater than they were at the age of five or six. In a normally developing child, as the nasal structures increase in size the distance from the cribriform plate of the ethmoid to the floor of the nose gradually increases, but in a mouth-breather growth in this direction, as in all others within the nose, is restricted. As related to the other bones of the face, we find the floor of the nose and the roof of the mouth assuming a constantly higher position. The roof of the mouth is anchored, so to speak, to a dwarfed nose. The alveolar processes of the maxilla, on the contrary, are more affected in the direction than in the extent of their growth. Being somewhat outside the zone of restricted growth, they are able to develop freely in a downward direction, but their lateral expansion is interfered with by the pull of their connection with the central portion of the hard palate.

We have, then, as a result of the forces operating as described, the median portion of the palate held high up in its early premature position. The alveolar processes, less restricted in their development, lengthen and enlarge, but are drawn to a greater or less extent toward the median line, obliterating the broad dome shape of the hard palate and converting it into a narrow inverted U or V shape. Such a palatal arch is necessarily narrow; sometimes more

constricted upon one side than on the other, it is asymmetric or unilaterally flattened. Having less than the normal breadth, the teeth have insufficient room for eruption, and are rotated or displaced; the incisors are pushed forward and project, and in extreme cases, where the development of the entire jaw is sufficiently interfered with, we find the lower jaw, which has gone on in unrestricted growth, projecting beyond the upper. This, it seems to me, is the simple, natural, and entirely adequate explanation of the relation between mouth-breathing and the high-arched palate, and I have entered into it at some detail, not only because there seems to have been a great deal of misunderstanding and misinterpretation of the condition, but because a proper appreciation of the principles involved is necessary to a rational understanding and intelligent treatment of such cases.

ADENOIDS IN CHILDREN.

There is no condition in childhood which operates to produce nasal obstruction and mouth-breathing to anything like the extent adenoids do. The adenoid vegetations, so called, consist in an hypertrophy of the pharyngeal or so-called Luschka's tonsil, situated in the vault of the pharynx. When normal this tissue, of course, produces no ill effects, but when enlarged it is capable of producing a series of disturbances which for variety and far-reaching consequences is equalled, perhaps, by no other condition of disease. Adenoids are found at all ages, being occasionally seen in the new-born, while remnants of them have been observed in the septuagenarian. The condition more commonly manifests itself, however, between the ages of two and fourteen, and may then be found in all degrees of enlargement, from the slight thickening which produces but very few symptoms of any kind, to the enormous growths which completely block the posterior nares, and which, untreated, are capable of wrecking the development of a child physically, mentally, and even morally.

Under ordinary circumstances adenoids if untreated will atrophy and disappear at or about maturity; but this brings no encouragement to the situation, inasmuch as the damage caused by them will then be largely beyond repair. The removal of this obstruction in the nasopharynx at ma-

turity, by atrophy, does not avail to restore normal breathing, because the nose, not having developed, is not sufficiently roomy to supply by this channel the air needed by the mature organism, and the bony formation of the face having become fixed at maturity no further natural enlargement is possible.

A familiar figure to the rhinologist is the mouth-breathing patient of mature years, whose nasopharynx is entirely innocent of adenoids, and yet who bears the indubitable evidence of their one-time presence. The partly open mouth; the nasal cavities of almost infantile proportions; the high-arched palate with protruding or overlapping incisors; together with the adenoid expression proclaiming the dulled mentality—all are eloquent of that which has gone before.

Pathologically several types of enlargement of this tonsil are recognized. The two most common are the soft and the hard varieties. The soft variety consists of an almost formless mass spread throughout the nasopharynx. It is pultaceous in feeling, friable in consistence, and crumbles and bleeds very easily before the examining finger. The hard variety is more resistant to the touch, though it bleeds with comparative ease, and possesses the typical lobulated form which has caused the sensation imparted by it to the finger to be likened to that of a bunch of angleworms. Both varieties, instead of being confined to the central portion of the nasopharynx, are frequently found invading the fossa of Rosenmueller, in which location they press upon and produce congestion of the openings of the Eustachian tubes and are responsible for ear disturbances of various kinds. Sometimes they run so far down upon the posterior wall of the pharynx that they can be seen below the level of the soft palate, especially during the raising of the palate in gagging. In the rhinoscopic mirror they can be seen depending from the vault of the pharnyx, and to a greater or lesser extent encroaching upon the opening of the posterior nares.

The evil effects of enlarged adenoids, as has been intimated, are almost endless. I shall not try to enumerate them all, as such an attempt would probably exhaust your patience as well as my powers of description, but will content myself with calling attention to a

few of the more common. When of sufficient size to be obstructive the most prominent symptom is the nasal obstruction with the attendant mouth-breathing which we have been considering, though oral deformities are not the only results of obstructed nose-breathing, nor are they the most serious. The consequences of impaired nasal respiration are numerous and far-reaching. One of the inevitable results of mouth-breathing is the admission to the throat and lungs of air that has not been properly prepared. Air passing through the nose is not only filtered but also warmed and moistened. By virtue of the large secreting surfaces of the turbinals the air is charged with moisture, and their extensive convolutions act with surprising efficacy as radiators in supplying it with heat. It has been shown that air breathed into the nose at zero temperature is raised to blood-heat by the time it reaches the posterior nares. It can be easily seen, then, that air taken directly through the mouth, without this preparation, must have a very injurious effect upon the mucous membranes with which it comes in contact. Inflammatory processes are set up in the pharynx, larynx, trachea, and bronchi, and the lung tissue is weakened and rendered more susceptible to various forms of disease, of which the "great white plague" is the most prominent. It can be readily understood, too, that this unnatural use of the mouth must result in alteration of its secretions and the production of a condition of dryness which will have a pernicious effect upon the teeth.

One of the most constant, and to the otologist and rhinologist the most important, of the phenomena attending the adenoid condition is impairment of hearing. In just what way adenoids operate to affect the organ of hearing is a disputed question and one which cannot be entered into here, but deafness of considerable degree is very frequently caused by them, while acute inflammations of the middle ear often occur, with an occasional final result in mastoiditis, chronic suppurative otitis media, brain abscess, meningitis, or sinus thrombosis. The operation for adenoids in children suffering from a considerable degree of deafness often results in a restoration of the hearing in a few days or weeks.

Neurotic and psychic disturbances of various kinds are constantly found, and range from a slight hebetude or in-

ability to concentrate the attention, through nervousness, irritability, peevishness, and ill-temper, to mental dulness of an extreme type.

Nasal obstruction, mouth-breathing, the high-arched palate with dental deformities of all degrees; impairment of hearing, inflammation of the middle ear, and even death; the whole range of catarrhal conditions of the nose, throat, and lungs, and a broad and easy pathway laid for tuberculosis; impairment of the intellect, and mental and moral obliquities of many kinds—surely this is a mighty crop to spring from so small a seed! and yet this is but a part of the harvest.

Probably all are familiar with the extreme type of mouth-breathing which is produced by adenoids of large size. There is the open mouth with dropped jaw; the crowded teeth and dull eyes. The nostrils not being in use are collapsed and flattened. The muscles whose function it is to keep open and dilate the nostrils being atrophied, that part of the face about the nose and the upper lip has a peculiar dead and expressionless appearance. Such cases are not uncommon, and the diagnosis may be made from across the street. It is not always so easy, however. Not every child who is ill-tempered, deaf, or even a mouth-breather, has adenoids; and it may be said at the same time that many a child has adenoid obstruction and breathes with slightly parted lips, who would not ordinarily be suspected of mouth-breathing.

Fortunately for the dentist, however, he does not need to concern himself with the niceties of diagnosis in regard to this condition, and need only inquire into the matter when he is confronted with dental malformations associated with a high-arched palate. And again, fortunately, there is no single external indication of the presence of adenoids more diagnostic than the high-arched palate, of the existence and degree of which no one, of course, can better judge than the dentist. Having, then, a high-arched palate, what other signs or symptoms may we look for to justify or dispel our suspicion of adenoids? I shall speak of but five, which are the most common, and which in all ordinary cases will suffice to make a diagnosis.

SOME SIGNS SUGGESTING THE PRESENCE OF ADENOIDS.

The first is mouth-breathing. Often it is evident enough, but in other cases the child must be watched carefully to determine its presence. When there is doubt, the mother should make careful observation at night to see if the child sleeps with the mouth entirely closed. Many children breathe properly during the day who breathe through the mouth at night.

Second in importance come affections of the ears. Inquiry should be made as to the presence of deafness and the occurrence of earaches.

Third. Frequent colds, often associated with a slight cough, are very common in children with adenoid vegetations, and their occurrence even without other symptoms should arouse our suspicion.

Fourth. Is the child backward in mental development? Children having adenoids are as a rule behind their classes in school.

Fifth. Nervous symptoms. Is the child a so-called "nervous child"? Is he subject to night terrors, and does he wet the bed? There are a hundred other manifestations of an unstable nervous system, but these are the common ones.

These symptoms of course are not all found in every case, but there are usually present more than one, and sometimes all are seen together. Absolute information as to the extent and location of the growth can be obtained as a rule in but one way. Digital examination is not difficult, and with a little experience can be made so rapidly that little pain is inflicted. Nevertheless, such an examination always alarms children, and as the dentist is traditionally persona non grata to them, perhaps it would not be the part of wisdom to invest himself with any new horrors.

When it is necessary to make a digital examination, someone should grasp the child's hands; the doctor, standing behind it, should hold the head firmly in the hollow of his left arm; the palm and fingers of his left hand are placed under the chin, and the child being asked to open the mouth widely, the thumb of the left hand presses the cheek between the teeth so that the mouth cannot be closed. The index finger of the right hand is then introduced behind the soft palate and into the nasopharynx, the posterior border

or the septum is felt for and the finger swept from side to side, covering the entire surface of the nasopharynx and outlining any growth which may be present. Such an examination, if adenoids be present, usually causes bleeding from the nose, and the examining finger is found to be covered with blood.

There is but one method of treatment worth considering; radical removal is quick, safe, and effectual. It should be attempted, however, only by an operator thoroughly competent in such work, as partial removal usually means recurrence and the necessity for further operations, while the danger of inflicting damage upon the mouths of the Eustachian tubes by unskilful instrumentation in the nasopharynx is considerable.

In conclusion, it should be unnecessary to say that I do not intend to assert that all high-arched palates are the result of nasal obstruction, nor that all nasal obstruction is due to adenoids, but I think it is beyond question that a large percentage of this class of deformities is the result of adenoid obstruction, and that the dentist who fails to take it into account does his patients and himself a serious injustice. Any attempt to correct dental deformities resulting from this condition, without first removing the cause, is working against the forces of nature, and must result in only partial success, or in many cases a recurrence of the condition which may have been overcome by such tedious and painful efforts. If, on the contrary, the causative factor is recognized and removed as a preliminary step in corrective work, nature's powerful aid is enlisted in behalf of the operator, and with the establishment of nasal breathing and the normal development of the nose, the dentist may be assured that he is paddling with the current and not against it, and that—the wonderful achievements of orthodontia being established upon a rational basis—corrections once made will stay corrected.

XIV.

SOME OBSERVATIONS ON THE ACOUSTIC FUNCTION OF THE EAR.*

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The most important office of the otologist is to improve the acoustic function of the ear. It is self-evident that where life is endangered, the life becomes more important than the function of hearing, but this is fortunately a rare condition. To improve the acoustic function of the ear the otologist, to work intelligently, must make hearing tests. We all know how many reports of cases in otology are without scientific usefulness because of lack of adequate hearing tests. I know of clinics where hearing tests are never practiced and old chronic cases are treated year after year without benefit. It helps to swell the number of old cases treated. What would we think of an oculist who applied glasses without testing the vision? It is just as necessary for the otologist to find out the limits of the hearing field. Hearing tests enable us to make a better diagnosis, to give prognosis, and it is the most important means by which we can say that our treatment is doing good. It is untruthful to tell a patient that he has improved just because he thinks he has; it is not honest to tell a patient that treament will improve his hearing because we do not know; we must experiment, and before and after the experiment we need careful tests. If the patient has otosclerosis which can only be diagnosed by hearing tests, tell him so and get rid of him and later after having spent time and money with many doctors he will come back to you wishing he had taken your advice. If a patient has total deafness in one ear from labyrinth

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diseases we can establish the fact by the experiment of Voss. This experiment will save the patient many unnecessary visits. In a progressive deafness we have no way of estimating the rate of progression without hearing tests and many times the patient comes to us having had much treatment but never any hearing tests. We have all had cases where the patient had been treated for cerumen in the canal, instead of treatment for a catarrhal deafness overlooked for want of a hearing test.

Our facilities are often poor for testing the hearing, perhaps our offices are small and noisy, possibly our voices are husky and our articulation not plain, but nevertheless tests under these adverse conditions are valuable because the tests are relative and each doctor must establish his own standard. Deaf people are deaf or considered so because they do not hear what a normal hearing person hears. We do not have voices of uniform pitch or clear cut articulation.

Hearing tests with the tuning forks are very imperfect, but so is the hearing of most of us. Our patients are not all trained musicians. In testing we do not consider the temperature, the barometric pressure, air currents, external noises or the state of the patient. Our instruments are not all made by Edelmann and few of us possess the Bezold-Edelmann series of tuning forks, but for all practical purposes, the Hartmann set of forks with a fork of 80 v. s. and the Galton whistle are usually sufficient. I will not deal with the technic of the different tests in this paper. Dr. George Bönninghaus in his "Lehrbuch der Ohrenheilkunde" has written best on this subject.

Let us consider the C_1 fork of 512 v. s. It is impossible even with the aid of magnets to set the tuning fork in vibration with equal intensity, for changes in the electric current, the temperature, the barometric pressure, and in the wear of the fork itself, are constantly taking place. Ostmann inserts a separator between the arms of the fork, Gradenigo ties a lead weight by a string to one of the arms, then burns the string to get uniform intensity. A weight of 500 grams gives ten times the intensity of 50 grams. If a patient hears with his diseased ear, a sound made by 500 grams weight and a normal ear hears the same fork with a weight of 10 gr. the acuity of the deaf ear is

1/50 of the normal ear; 2/100. The low forks including 512 v. s. may be pressed together between the thumb and forefinger, slipping the fingers off at a given time. This gives a fairly uniform intensity. Hitting the forks against blocks of cork or the palm of hand loosens the clamps and the fork is soon worthless. The tone produced by the fork has the same pitch in the handle as in any part of the arms but the intensity varies; in other words the wave lengths are equal but the amplitude varies. The greatest sensation of loudness of sound is at right angles to the broad or I side or at right angles to the narrow or U side, near the prongs; these intensities are equal, but the intensity of sound grows less as the ear approaches the handle of the fork. One cannot listen to a sound of a given intensity and then distinguish a sound which has half that intensity; all one can say is that the intensity is greater or less than a given intensity. Turning the tuning fork in its vertical axis, we find four nodes where the sound is only slightly heard or not heard at all. By interference the waves neutralize with each other. The I side must begin with a crest and the U side with a hollow so the waves cancel each other.

Another interesting fact about the 512 v. s. tuning fork is that if the fork is set in vibration and the handle is carried into the external auditory canal the sound will be heard as long as that of the weighted end of the fork. Therefore I find it more satisfactory to make the air-conduction hearing tests with a combined fork and rubber tube. Take a rubber tube two or three feet long which fits snugly over the handle of the hearing fork. On the end which is placed in the patient's auditory canal I insert one of Jansen's tips. A 512 v. s. fork heard 50 seconds by the usual method will be heard about 50 seconds by the tube method with the further advantage of non-interference with the vibrating fork. There is no danger of touching the auricle or hairs of the tragus. The wavy hair falling over women's ears is very annoying at times. With the tube method there can be no variation in intensity according to the position in which the fork is held. The rubber tube is slipped over the handle about half an inch and the fingers hold the part of the handle covered by the

rubber, so that the part in contact with the fingers is fairly constant.

Below is a table worked out from the ordinary imperfect tuning forks found on the market, called Hartmann's set, together with a low fork of 80 v. s. and F_4 fork. We can feel, see and hear the vibrating tuning fork. We hear it in two ways, by air and so-called bone-air conduction. We can see the vibrations without special devices only when looking at the U side of low vibrating forks.

Forks.	Tactile time. Thumb and Forefinger.	Sight.	Hearing. Bone-air Conduction.	Hearing. Air Conduction.
80 v. s.	8″	7″	3″	6″
C 256 v. s.	55″	30″	38″	90″
C_1 512 v. s.	30″	15″	25″	50″
C_2 1024 v. s.	10″	0″	20″	40″
C_3 2048 v. s.	0″	0″	8″	45″
C_4 4096 v. s.	0″	0″	0″?	35″
F_4 4720 v. s.	0″	0″	0″?	22″

It will be seen that the tactile pressure sense is of greater duration than the sense of sight and greater than bone-air conduction up to C_2. Bone-air conduction with C_2 and C_3 forks becomes confused because the sound is heard by air conduction.

Normally we hear by one method, namely by air, but pathologically we may be helped by bone-air conduction. The proof is easy from an anatomic and physical point of view. Let us first take a tuning fork and cause it to vibrate, then place it on different parts of the body. Roughly speaking the fork is heard longer, the nearer it approaches the external auditory canal. The intensity of the sound varies according to the pressure with which it is held against the body; that is, up to a certain degree, the greater the pressure the louder the sound. The fork is heard more distinctly when the handle is placed squarely on the pressed surface. Tipping the fork varies the intensity of the sound. The fork is heard loudest and longest when the base is pressed firmly and squarely on the surface of the tested part. All forks vary in duration, even those of the same pitch. The fork is heard for a certain length of time on the patella, longer time on the sternum, still longer

over the lower part of the nasal bones, sometimes longer against the upper incisor teeth and longest over the condyle of the mandible, just anterior to the tragus. The mastoid fossa position without contact with the auricle is of shorter duration in most cases than the nasal vomer position. The velocity of sound is faster in the perilymph than in the air and faster in bone than in fluid but the distances in the human body are so short, and our estimation of time is so slow that this factor plays no part in our sense of hearing. It is not normal to hear by bone conduction. If we did hear by bone-air condition the sounds taken up from the ground and the floors in large buildings, carriages or trains would be unbearable. Even our own voices would destroy our hearing. Barth says, "that autophonia is a pathological condition existing where the Eustachian tube is wide open or where the external auditory canal is stopped up. By auscultation, the hearing tube conveys the increased sound to the examiner." The boiler maker suffers because he can't make use of his bone conduction. Nature has protected us by placing the auditory hair cells in endolymph, surrounded by perilymph of the scala vestibuli on one side and the scala tympani on the other; then comes the dense hard bone of the cochlea, and around the cochlea there are air cells or at least diploetic cells filled with marrow, and then more dense bone, and brain, mucles, or air cavities according to directions. I consider the large blood vessels the most important dampening factor. The carotid artery and the numerous blood sinuses all tend to carry away any encroaching sound. The sound made by the pulsation of the neighboring carotid artery is probably diffused by the surrounding plexus of small veins. Whenever the equilibrium of the ossicular chain is interfered with, bone conduction is prolonged, therefore bone-air conduction is of great importance to the otologist as a record of the pathology and also the acoustic function of the ear. Tonietti* says, that bone conduction is shortened in chronic alcoholism, general paralysis, brain syphilis, epilepsy, and traumatic neuroses.

Simulation is a very interesting subject. Those who simulate deafness, partial, total or one-sided deafness, are

*Arch. ital. di otol., etc., Vol. xviii, fasc. 6.

easily detected by repeated tuning fork tests. One can go quietly to work and the faker cannot tell what he should answer and soon becomes confused. The brush experiment of Gowseeff† is very good to detect those who simulate total deafness. After blindfolding a soldier, who claimed to be totally deaf in one ear I found he would only hear the whispered voice when I held my finger resting on his shoulder, so I substituted a hooked umbrella for my finger which I rested on his shoulder and he heard me when I was twenty-five feet away.

†Zeit. f. Ohren., LI. 3, p. 280, 1906.

XV.

A THEORY ON THE FUNCTION OF THE MIDDLE EAR MUSCLES, RESULTING IN A MODIFICATION OF THE THEORY OF HEARING*.

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The muscles of the tympanum are not fully understood. According to Dr. Robert Wiedersheim[1] on the auditory organs of mammals, "Two striated muscles are present in connection with the middle ear. The phyletically older stapedius, arises from the wall of the tympanic cavity and is inserted into the stapes, serving to keep the membrane of the fenestra vestibuli stretched. It is supplied by the facial nerve and corresponds to the dorsal portion of the deep constrictor inserted on the hyoid in fishes, from which the hinder belly of the biventor of mammals also arises. A tensor tympani, supplied by the mandibular division of the trigeminal and derived from the system of the adductor mandibulae (pars pterygoidea)†, also arises from the wall of the tympanic cavity, and is inserted on the manubrium of the malleus, serving to stretch the tympanic membrane."

v. Hensen[2] says, "The question of whether the Eustachian tube is wide open or closed is not yet wholly settled. Lucae has observed respiratory movements, and by in-

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†"In Man the tensor tympani is from the first connected with the tensor veli palatini muscle. In Ornithorhynchus it has a double origin, one part being continuous with the pharyngeal muscles and the other arising independently. A stapedius muscle is wanting in Ornithorhynchus and Echidna, and a tensor tympani in Manis; and in all these three animals the tympanic cavity is subdivided into an upper and lower portion by a horizontal septum of connective tissue."

spection, bulging was more frequent than retraction. Helmholz, believed the tube to be closed, and that only compressed air entered the middle ear." On the function of the muscles of the middle ear apparatus, Hensen and Bockendahl have experimented to determine the amount of movement made by the tensor tympani during its reaction to sound. The tympanic cavity was opened and a light, sensitive lever inserted in the tendon of the tensor tympani muscle. The higher the note, the greater the contraction. Bockendahl found that once the needle remained stationary under the influence of a continuous sound. It could have occurred through unfavorable insertion of the needle, or an actual long contraction (tetanic). In Hensen's experiments the needle sank back to a state of rest when a continuous tone was sounded. Pollock, confirmed these experiments. He found that the reaction disappeared completely with the destruction of both labyrinths. Hammerschlag experimented on cats and dogs and found that the action of the tensor reflex from the acoustic to the trigeminus nucleus, is by the corpus trapezoideus and not by the striae acousticae. Hensen, first observed that after hearing a very weak tone, if the ear was closed and again opened after a short time, the tone would again be heard. Hensen holds this for an accommodative phenomena. He found too, that a tone of 400 or more vibrations was clearly intensified, when at the same time a metronome was in action. When the beats were over 200 a minute the reaction stopped. That the membrana tympani was not in tension, but on the border between tension and relaxation and was made tense by the sound of the metronome could not be excluded or the other possibility, that of a pure contrast action could not be excluded. J. Mueller believes that these muscles act as sound dampners and protectors. Hensen shows that if an explosion is not known beforehand, and if the muscles served as a guardian angel, causing a contraction before the sound impulse struck the ear, it would be a false protector, for a tense membrane would be more easily torn than a relaxed membrane. Protection would only take place during relaxation, and then, even the labyrinth would be more protected. "Politzer[3] has experimentally proved that the action of the tensor is not confined to the membrana tympani alone, but also the

labyrinth, inasmuch as he observes a motion of the fluid in the labyrinth on electrical irritation of the root of the trigeminus. The tensor tympani therefore increases the pressure in the labyrinth. The stapedius muscle, on the other hand, must be regarded as the antagonist of the tensor tympani, as the author has shown by irritation of the facial nerve in the cranial cavity (Wiener Med. 1878); it relaxes the tympanic membrane, and diminishes the pressure in the labyrinth." McKendrick[4] says, "From experiments conducted hitherto, we can only state that one of the principal functions of the intratympanic muscles is to relieve alterations in the position and tension of the ossicular chain and abnormal pressure in the labyrinth which are brought about by the variable fluctuations in the air pressures in the external and middle ear. They, therefore, regulate the degree of tension of the hearing apparatus." "When the tensor tympani contracts, the membrana tympani becomes more tense. The normal stimulus which causes the tensor tympani to contract is the pressure of sound waves on the membrana tympani. Although the innervation of the membrane has not been conclusively established there is little doubt that it is supplied with sensory nerves by the fifth, and also by the tympanic plexus, formed by fibres derived from the otic ganglion, from the petrosal ganglion of the glossopharyngeal, and from the carotid plexus. When pressure is made on the membrana, there is irritation of these sensory nerves, followed by a reflex contraction of the tensor tympani, supplied by a motor filament from the motor division of the fifth nerve." (See experiments of Hensen and Bockendahl[2].) "The tensor tympani also contracts during yawning. In a few cases the muscle appears to be under the control of the will. We have no direct evidence of any reflex excitation of the stapedius, but one would expect it to respond in a manner analogous to the response of the tensor tympani. Lucae first observed that the contraction of certain muscles of the face, most easily the musculus orbicularis oculi, can produce a simultaneous contraction of the stapedius. This is made evident by a deep humming sound in the ear, and also a relaxation of the tympanic membrane as shown by the manometer. During such re-

flex contractions the perception for the lower and middle tones of the tuning forks is discontinued."

G. Bönninghaus[8] says, "The hypotheses are many as to the function of the muscles of the midle ear apparatus. It is generally thought that the muscles give a moderate tension to the sound conducting apparatus which is best suited for vibrations, and besides exercises a kind of accommodation analagous to the intrinsic muscles of the eye. Now, on the existence of this accommodation, opinions differ widely, although all acceptors take for a basis of accommodation, that the stapedius is the antagonist of the tensor; that, therefore, the foot plate of the stapes is raised out of the labyrinth (Politzer); whereas the action of the tensor pushes the foot plate in, an opinion which is very doubtful because the stapedius, as actual antagonist, is much too weak. A further criticism however on these opinions would be an unthankful task while the whole knowledge of accommodation is today the darkest point in the physiology of the ear."

These theories fail to meet the requirements of sound conduction. A number of facts are collected without any definite idea of relation. My theory is as follows: The atmospheric pressure presses on the membrana tympani constantly by way of the external auditory canal; it presses from within on the membrana tympani by way of the Eustachian tube only when the tube is opened. The tube is opened during the act of deglutition by the action of the levator and tensor palati (dilator tubae). At the same time the soft palate is forced upward, compressing the air in the nasopharynx. This compression plus the existing atmospheric pressure and the increase in volume by heat and moisture sends the air into the anatomic middle ear, that is, the Eustachian tube, the tympanic cavity, the mastoid antrum and the pneumatic cells of the mastoid. What happens when this bolus of air is forced into the middle ear? The pressure in the middle ear becomes greater than the extratympanic (atmospheric) pressure, hence the head of the malleus is separated from the head of the incus, the liquid in the manometer of Politzer rises; then the tensor tympani muscle slowly contracts, due to the stretch of its tendon, and the head of the malleus again locks with the head of the incus; the fluid in the manometer falls. During

this adjustment vibratory pressures (sounds) are poorly transmitted. Meanwhile the air in the middle ear is being absorbed while the work of the tensor tympani is growing less, due to the lessened intratympanic pressure. The absorption of air in the middle ear causes a continuous variation in pressure. As the intratympanic pressure lessens, the tensor tympani muscle gradually relaxes till the intratympanic pressure equalizes the extratympanic pressure when both tensor tympani and stapedius muscles are at rest. Now the absorption of air continues, and the intratympanic pressure becomes less than the extratympanic pressure. The stapedius muscle begins its work to keep the foot plate from being pushed into the vestibular window, and again to establish the equilibrium of the ossicular chain. Soon, due to reflex action, another swallow takes place and the tensor tympani begins its work again while the stapedius muscle rests. (See diagram.) At the time of deglutition the stapedius muscle relaxes and the tensor tympani muscle contracts.

What are the advantages of this theory? They are many, for it gives us a rational physiologic action of muscles. These muscles do not act primarily to keep certain membranes tense or adapt them to certain sounds but to equalize constant pressures, and this adaptation to constant pressures brings about an ideal tension of the whole drum-ossicular apparatus causing this apparatus to be in a state of equilibrium, the best possible condition to conduct any and all sounds. What would result if the Eustachian tube remained open? If we had patent tubes, we would hear our own voices, as if we talked in a barrel, besides the tensor tympani and stapedius muscles would soon cease to act; for the tensor tympani would have to be in a state of constant contraction to overcome the slightly increased intratympanic pressure over the extratympanic pressure due to the increased volume by heat and moisture. Without contraction of the tensor there would be no tension and so no equilibrium. The muscle would become hypertrophied, and then degenerate, while the fate of the stapedius muscle would be atrophy, from no work to do. Muscles must have their periods of rest. Thus you see these muscles are accommodative to intra- and extratympanic pressures and only indirectly subserve sound or vibratory pres-

sures. Physiology has taught us that it takes time for a muscle to contract. We know that after swallowing it takes a short time to hear plainly again, and also after a patient's ears are inflated the tensor tympani may be some minutes or hours before it is able to overcome the intratympanic pressure and keep the head of the malleus in locked apposition with the head of the incus. Sounds do not wait. It is difficult to think of muscles accommodating themselves to sounds. We hear immediately. These muscles are too slow to accommodate our middle ear apparatus to the sounds of an orchestra but rather they keep the apparatus in an ideal state of equilibrium. While the tensor tympanic muscle was adjusting itself to the base violin, the piccolo would be lost, according to the old theories. An explosion has no consideration for the intrinsic muscles; it ruptures the drum membrane or wrecks the labyrinth if we are close enough. Even the ciliary muscle of the eye does not act immediately to a strong light, we may watch it contract. The function of the intrinsic muscles is to keep the middle ear apparatus in equilibrium so that vibratory pressures may be conveyed to the perilymph. It is ready at all times to receive the simplest to the most complex combinations of sound.

Let us consider the drum membrane itself. We have a membrane supplied with radial and circular elastic fibres, which takes care of itself and because of its elasticity it adapts itself to circumstances. When the intratympanic pressure is greater than the extratympanic pressure it bulges out into the auditory canal; when these pressures are equal it flattens out due to its elasticity, and when the extratympanic (atmospheric) pressure is greater than the intratympanic pressure it is pressed inward, and yet, due to the tension of the tensor tympanic muscle, the general shape of the membrana tympani is always cone or megaphone shaped. (See diagram.) I have already shown why the fluid in the manometer of Politzer rises and falls after deglutition. I believe that if the tensor tympani muscle reacts to sound that all muscles will react to sound. I consider the metronome tuning fork experiment a contrast reaction. I consider the contraction of the stapedius muscle when the eyes are tightly closed a defensive reflex. This action takes place when we expect an explosion or

a blow of some kind. The tensor tympani does not contract to make the membrana tympani more tense, the normal stimulus is not the pressure of the sound waves, but the tensor tympani muscle does contract for reasons I have set forth in my theory.

How does deglutition take place? Dr. Foster[6] on the submaxillary gland says, "In life, then, the flow of saliva is brought about by the advent to the gland along the chorda tympani of efferent impulses, started chiefly by reflex actions." "Thus stimulation of the chorda brings about two events: a dilatation of the blood vessels of the gland and a flow of saliva." "When the cervical sympathetic is stimulated the vascular effects are the exact contrary of those seen when the chorda is stimulated. The sympathetic therefore acts as a vasoconstrictor nerve, and in this sense is antagonistic to the chorda." "Thus the secretion of the parotid gland, like that of the submaxillary, is governed by two sets of fibres, one of cerebro-spinal origin, running along the auriculo-temporal branch of the fifth nerve but originating possibly in the glosso-pharyngeal, and the other of sympathetic origin coming from the cervical sympathetic." Dr. J. P. Morat[7] on deglutition says, "At the entrance of the digestive paths we are confronted by an act which forms the transition between those of external and those of internal function, that is deglutition, which commences with an act of conscious sensibility and voluntary movement and is completed by reflex movements. Once again it is the medulla oblongata which is the locality for the organization of the system subserving deglutition, the conducting fibres, both sensory and motor, of this system being met with in a certain number of bulbar nerves, namely, the trigeminal (mylohyoid muscles), the facial, the hypoglossal, and the vago-spinal, which perform the function of motor nerves connected with sensory elements contained in the palatine nerves (of the superior maxillary), the superior laryngeal nerves, and lastly, the glossopharyngeal which are less essential than the preceding. The point of departure is the irritation of the bolus of food occurring at the level of the isthmus on the extremities of the palatine nerves. The laryngeal nerves intervene to defend the entrance of the respiratory paths. The center of association of these different nerves

is situated between two planes of which the superior passes through the acoustic tubercle and the inferior through the apex of the calamus; according to Markwald, a little above and outside of the grey wing, above the respiratory centre. Sections made above or below the limits just pointed out permit of the persistence of swallowing (life being maintained by artificial respiration)."

In establishing a swallowing reflex induced during negative intratympanic pressure I do not concern myself with the tensor tympani muscle or the trigeminal palatal muscle, the tensor palati (positive intratympanic pressure), but with the phyletically older muscle, the stapedius. Near the end of the negative pressure phase fatigue of the stapedius muscle takes place, while the negative pressure of the midle ear increases the blood supply of the perineurium of the chorda tympani. This stimulation increases the flow of saliva from the submaxillary and sublingual glands, while stimulation of the glossopharyngeal nerve by the same dilatation of vessels around the nerves of the tympanic plexus would cause an increased flow of saliva from the parotid gland. This flow of saliva would be followed by the act of swallowing and the positive intratympanic pressure would again be established. If swallowing does not send a bolus of air into the middle ear, because of paralysis of the vago-accessory group of muscles or of inflammation around or in the Eustachian tube, then we have the starting point of diseases in the middle ear. There is probably no definite rhythm to this swallowing reflex.

If there is anything in this theory of the action of the intrinsic muscles of the middle ear, then the theory of hearing must be modified. The theory of hearing has interested many groups of thinkers, the Physicist, the Anatomist and Histologist, the Physiologist, the Pathologist, the Psychologist, the Mathematician, the Philosopher, the Neurologist, the Psychiatrist, the Embryologist, the Biologist, and principally the Otologist, one of the youngest of these groups but most important because he is in constant contact with diseased conditions of the ear, and has opportunity to apply the work done by others to his specialty.

Consideration of Sound.—What is sound? The definition

in the Century Dictionary is "1. The sensation produced through the ear or organ of hearing; in the physical sense, either the vibration of the sounding body itself or those of the air or other medium, which are caused by the sounding body and which immediately affect the ear." Sharpless and Philips[8] say, "Sound is a vibration. All sound is caused by a vibration of some body." Dr. M. Foster[9] says, "Sound is a vibration of the particles of matter, a series of movements of the particles from and to a fixed point. In air and other gases the movement of the particles lead to alternating condensation and rarefaction of the medium, the sound is propagated as waves of alternating condensation and rarefaction which since the to and fro movement of the particles is in the same direction as that in which the undulations are traveling are spoken of as longitudinal waves. Henry S. Carhart[9] says, "Sound may be defined as a vibratory movement excited in an elastic body and transmitted to the ear by means of a continuous elastic ponderable medium." The Standard Dictionary gives the following definition,—"Sound: 1. The sensation produced through the organ of hearing. 2. The physical cause of this sensation; waves of alternate condensation and rarefaction passing through an elastic body, whether solid, liquid, or gaseous, but especially through the atmosphere." Dr. Scripture[12] says, "Sounds are purely mental experiences, most of which are the results of vibratory movements reaching the ear through the air." These definitions vary considerably.

My conception of sound is, sound is vibratory pressure. It is kinetic energy. To the human ear vibrations between 30 and 40,000 v. s. are called sound. Wien[10], found that the faintest audible tone of 240 vibrations had energy amounting to 0.068 uumg. It is necessary to explain the two systems of physical equilibrium before we can register pressures of such slight energy. The first system I have already explained and is the equilibrium of the ossicular chain brought about by the intrinsic muscles of the middle ear; that system has to do with equilibrium of air pressures. The second system is the equilibrium between the perilymph and the endolymph, a system of equilibrium of fluid pressures, and lastly consideration of the intratympanic pressure on the oval and round window membranes.

I will now discuss the second system of equilibrium. The tube of the cochlea contains endolymph. Pressures may be transmitted to the endolymph in two ways: first, pressures from within the tube, and second, pressures from without. 1. The pressures from within may be caused by increase of secretion from the secreting tubules (Schambaugh) and the stria vascularis of the spiral ligament. 2. Pressures from without are caused by pressures transmitted in two ways, (a) pressures from the perilymph; and (b) brain pressures exerted on the saccus endolymphaticus. The pressure exerted on Reisner's membrane from the endolymph must equal the pressure from the perilymph to keep this membrane in a state of equilibrium. The perilymph communicates by the aqueductus cochleae with the arachnoid space and so with the ventricles of the brain and the spinal canal. Any undue increase of fluid in the ventricles would increase the brain pressure which presses also on the saccus endolymphaticus and by the aqueductus vestibuli equalizes the pressure in the endolymph. Thus the pressure within and without the cochlear canal is equalized. If the endolymphatic pressure were greater than the perilymphatic pressure, Reisner's membrane would bulge into the scala vestibuli, and if the perilymphatic pressure were greater than the endolymphatic pressure, Reisner's membrane would bulge towards the organ of Corti.

Now, consideration of the intratympanic pressure on the perilymph. The vestibular window is nearly filled with the pressure plunger, the stapes. The stapes is not solid but disk shaped with two light, but strong crura made like the ribs of an umbrella. The intratympanic pressure presses on the foot plate of the stapes and the same intratympanic pressure presses on the cochlea window membrane. In other words, although the intratympanic pressure is constantly changing by renewal and absorption of air, this pressure never produces any change on the fluid of the perilymph. Now with the middle ear apparatus and the internal ear fluids in equilibrium we are prepared to receive the vibratory pressures from 24 to 40,000 v. s. These vibratory pressures must be of sufficient intensity to register on the perilymph.

What is pressure? The definition given in the Century

Dictionary is as follows: "A force per unit area exerted over the surface of a body or part of a body, and toward the interior of the body. A force exerted upon a surface is necessarily equilibrated; otherwise, since the surface has no mass, it would produce infinite velocity until equilibrium ensued.

A pressure can produce no motion, because it is in a state of equilibrium; but a continuous variation of pressure in a given direction will tend to produce motion toward the place of less pressure." It is because of the fact that there is continuous variation of pressure, condensation and rarefaction, that sound travels. The biologist informs us that the lowest forms of life have feeling; a pressure sense, and this sense is skin deep, it is near the surface. Embryology teaches us that the ear is developed from the ectoderm. This organ is a highly developed pressure organ, the ear registering pressure vibrations which we call sound as the eye registers pressure vibrations called light. This process of development has been slow; time is of little account. Evolution is slow. It is interesting to note that the ear at birth is anatomically nearly as fully developed as in the adult. In the fish we find that the auditory nerve goes to a line of lateral pressure organs. It is a known fact that feeling blends with hearing. We feel vibrations up to 24 to 40 v. s. a second, then we begin to hear the vibratory pressures and even feel them above 1024 v. s. Some individuals have a keener sense of touch than others. The duration of a tuning fork held by thumb and forefinger might be a valuable test for neurologists. If we did not hear but could only feel a vibrating body we could soon differentiate low vibrations from higher ones, although we would receive no sensation of tone.

Before examining some of the anatomic facts of the organ of hearing which have to do with acoustics, let us consider a few laws of pneumostatics and hydrostatics, for we have to study the effects of vibratory pressure in air and in fluid. I have already shown* that vibratory pressure has largely been eliminated in solids by surrounding the cochlea with efficient non-conductors (cells filled with bone marrow and air cells) and currents of blood. It

*Paper on Some Observations of the Acoustic Function of the Ear.

is easier to think of the static condition of water than that of a gas like air. The similarity of water and air is striking. Both are made up of gases, and oxygen is common to both. We live at the bottom of a sea of atmosphere of a depth of one hundred miles or more, which varies from day to day and hour to hour as the barometer records. The birds of the air, correspond to the fishes of the sea, while we compare to the lobsters and crabs. Of late years we are attempting to fly. The falling of a book or stone causes waves of air to travel in all directions and this vibratory pressure we call sound. Vibrations where there is no pressure causes no sound, as the experiment of the clock in the vacuum proves, but a perfect vacuum is impossible to obtain, therefore there must be sound if there is the least pressure, although such sounds could not be heard by the human ear. As we go higher in the atmosphere the pressure becomes less, for example in climbing a mountain or ascending in a balloon. In these high altitudes sound is harder to make and does not travel so fast or so far. The sounds in the valley are heard in the mountain, but sounds of the same kind on the mountain are not heard in the valley. The denser the air, the further a given sound will be heard by the ear. Did you ever notice that patients with so-called catarrhal deafness due to inflammation of the Eustachian tube complain of their deafness in damp weather. They blame the dampness whereas it is the atmospheric pressure they should blame; the nearer the sea level such patients live the better for their ears, because there, the atmospheric pressure is at its maximum. In the large sense, sound or vibratory pressure does not travel equally in all directions but travels equally in all directions in a stratum which is subject to the same pressure, provided there are no air currents or interfering media other than air. A sound of equal pitch and intensity travels farther from a high pressure to a low pressure, than from a low pressure to a high pressure. As to atmospheric pressure, we must consider it practically constant, for except in diseased conditions it does not play much part in acoustics.

What is the organ of Corti? The organ of Corti is a hydrostatic dynamometer and registers vibratory pressures. For years we have been trying to make sound vibrate certain elements in the cochlea as though we had a piano or

some stringed instrument in the head which must resonate to the sound heard. Sound waves travel like the water waves when a stone is thrown into a pond. If one is not in the radius of the air waves or if the air waves are not of sufficient amplitude to register on the hydrostatic dynamometer the sound is not heard. Physics teaches us that whatever pressure we apply to a fluid in a closed vessel, the fluid transmits the pressure through its whole substance, so that even the faintest audible sounds must register on a perfectly equilibrated system such as we have described. The auditory hairs in the basal coil register only vibratory pressures which correspond to high tones, while the auditory hairs near the cupola register the vibratory pressures of low tones. Each auditory hair or group of hairs is sensitive to its own particular vibratory pressure which when stimulated by this vibratory pressure sends an impulse to the cortex where tone perception takes place according to the education of the brain cortex for tones.

Anatomic considerations of the organ of Corti. We have a mound with about 385,000 sensory hairs. These hairs are within the tube of the cochlea which is in no way in apposition with pressures of the outside world. The organ of Corti is supported on a water bed beneath its own supporting basilar membrane. This water bed is the perilymph of the scala tympani. Above the organ of Corti is the delicate membrane of Reisner which is the transmitting membrane of vibratory pressures from the perilymph to the endolymph. I can consider the tectorial membrane only as a protector and dampner. In the physical sense it is a floating body immersed in a liquid. I find in my sections of the human tectorial membrane fibres arranged in a transverse and longitudinal manner. There are many more of the transverse fibres than of the longitudinal. We do not know whether our fixing reagents give us a false idea of this structure. It may be an artefact. In saying that the scala vestibuli is above, I am speaking of the microscopic picture, for in a closed cavity filled with fluid, position plays no part, it does not effect the transmission of vibratory or constant pressures. We hear standing on our heads or lying down, as well as standing on our feet. The rods of Corti give strength to the structure which receives pressure from above. Let us consider that

we have an equilibrated middle and internal ear apparatus. Now if a vibratory pressure of 80 v. s. sets the stapes in vibration in the vestibular window, then this vibratory pressure travels equally in all directions in the perilymph, around the membranous semicircular canals, around the utricle and saccule and up the scala vestibuli pressing equally on Reisner's membrane from the beginning of the cochlear duct to the end, and then through the heliotrema, and down the scala tympani pressing on the cochlea window with the same force that was exerted on the vestibular window. The area of the vestibular window is about twice that of the cochlea window. Dr. A. G. Pohlman of Indiana University found the proportion was 1.7:8.5 in one and 1.72:9 in the other or practically 2:1. The shape of the cochlea, the very gradual winding staircase containing the cochlear duct 35mm. long with a height of 5mm. from base to apex, is so small, that depth of fluid does not play much part in the acoustic function. It is evident that it would take more pressure to influence the endolymph by way of the basilar membrane than by way of Reisner's membrane. It is impossible to think of the basilar membrane responding to vibratory pressures. Now with the middle ear muscles at work preserving equilibrium and a perfect equilibrium of the internal ear fluids, any vibratory pressure will press on the auditory hairs the whole length of the cochlear duct equally, but only the hairs or hair sensitive to that particular vibratory pressure will be stimulated. Music does not need to be reproduced as music in the cochlea to be perceived, because all vibratory pressure however complicated is registered by the auditory hairs. The combined vibratory pressures making the compound sound of any one moment forms a wave like that seen when the style of a gramophone carves deeply or lightly into the wax never making two similar waves. Every sound makes its impression on the ear if of sufficient intensity and within the field of hearing to be registered by the stapes in fluid. Thus the complex vibratory pressures exerted on the auditory hairs of the conductor of an orchestra are analyzed as to pitch, intensity and timbre at any one moment. Thus the autoist or engineer hears a new vibratory pressure or misses an old one as the eye analyzes the pressure of color, light and shade.

It is interesting to note that the savage thousands of years ago in rubbing two dry sticks together stimulated all his senses but taste, first feeling, then hearing and, with the heat, odor stimulating the sense of smell, and lastly fire whose light stimulated sight. Thus heat, electricity, sound and light are all vibratory pressures or kinetic energy from some one source.

The membrana tympani is shaped like a megaphone. The membrana tympani acts like a screen to all vibratory pressures which would tend to act directly on the membrane of the cochlea window. If the intensity of a sound is great, some of the sound passes through, and if the sound is still more intense, all other sounds less intense are drowned out. The position of the cochlea window membrane at right angles to the foot plate of the stapes, and the fact that it lies at the bottom of a short tube, is probably for protective purposes. The middle ear pressure acts equally in all directions and those intense vibratory pressures which pass through the membrana tympani act equally in all directions but they do not dash against the cochlea membrane directly. These vagabond vibratory pressures are very interesting. The screen action of the membrana tympani may be demonstrated by placing a piece of gold beater's skin between a tuning fork and the ear. It will be noticed that the sound grows dimmer when the membrane intervenes and increases on removal. This interference of waves is seen on the lee side of the boat. A membrane like that of the membrana tympani will so dampen the tones of a low vibratory pressure that the intensity of the waves passing through will be so weak that no tone is heard. Sounds of high pitch with short waves and great intensity will pass through less changed and are heard in spite of the membrana tympani. In the same way a membrane will cast a shadow to light waves, but would let some light through, depending on the intensity of the light, the character of light, and the thickness of the membrane as well as its color. The same is true of heat and electric waves.

Jansen in 1899 first drew my attention to the fact that the pathology of the membrana tympani gave no indication of the acoustic function of the ear. We have all seen drums of deafness and where the voice and fork tests could dis-

weighted with calcified areas when there was no complaint cover no limitation in the field of hearing. It does not matter so long as the equilibrium of the midle ear apparatus is maintained. If we look upon sound as a vibration which must cause some part of the organ of Corti to resonate, these pathologic conditions cannot be accounted for. Time does not permit of accounting for all conditions in the middle ear. A patient without any ossicles often hears better than a patient with a fixed or retarded ossicular apparatus. A patient without drum membrane, malleus or incus but with a moveable foot plate still hears because he has hydraulic balance and so vibratory pressures register with the exception of the low tones because of the drum-ossicular chain apparatus, which Helmholz[11] proved transformed motions of great amplitude and little force into motions of small amplitude and great force. Ankylosis of the stapes plus rigidity of the cochlea window membrane by new growth should render a person deaf to all vibratory pressures. I have seen many patients whose hearing had been made worse by irrational treatment and I know of two cases where commotio labyrinthi had been caused by great intratympanic pressures. If you inflate the middle ear with a gentle squeeze of the Politzer bag you cannot improve matters by increasing the pressure. I have known otologists to use a pressure of 40 pounds on the middle ear. Never use air tank pressures. The thickness of the membrana tympani is not an index to the membrane of the cochlea window, and besides the danger in wrecking the organ of Corti there is great danger of stretching ligaments and rupturing membranes or bands with resulting bleeding. From these ruptures new connective tissue is formed and finally contraction of the scar tissue renders the equilibrium less efficient and deafness rapidly progresses.

In conclusion, I hope I have gained a bit of truth in this interesting subject. If I have not I hope it will stimulate others to think along these lines. A rational conception of how we hear will help us in our treatment of all forms of deafness.

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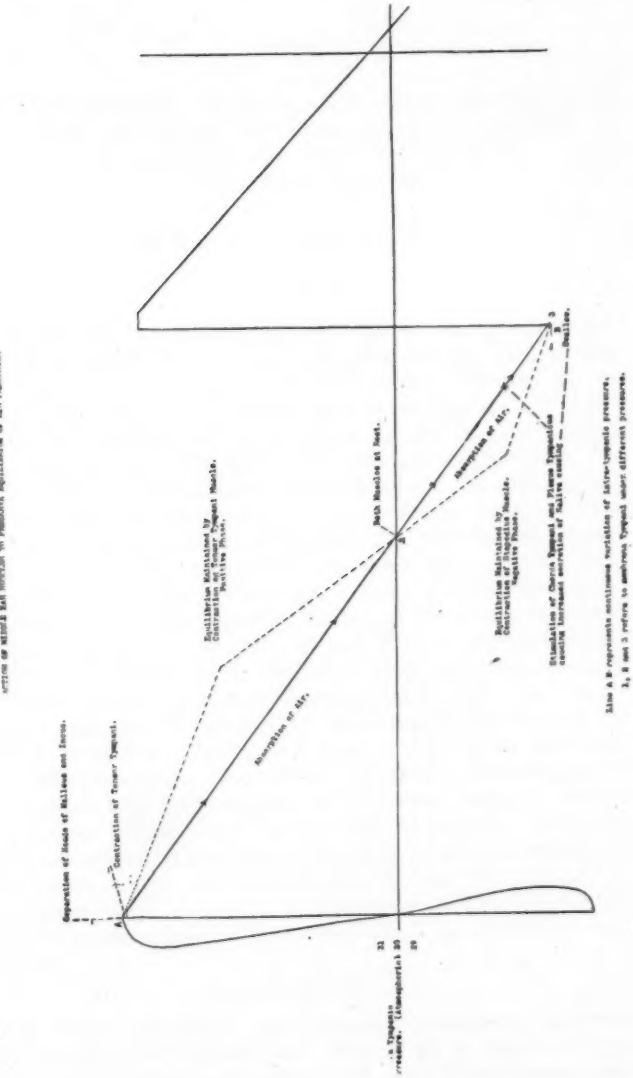
Both Muscles at Rest.
Absorption of Air.
Absorption of Air.
Equilibrium Maintained by Contraction of Tensor Tympani Muscle. Positive Phase.
Equilibrium Maintained by Contraction of Stapedius Muscle. Negative Phase.
Stimulation of Tensor Tympani and Stapedius causing Increased Secretion of Saliva causing
Saliva.
Separation of Heads of Malleus and Incus.
Contraction of Tensor Tympani.
Also A B represents continuous variation of intra-tympanic pressure.
1, 2 and 3 refers to numerous Tympani under different pressures.

XVI.

EXPERIMENTAL NYSTAGMUS AND AN APPLICATION OF ITS PRINCIPLES TO A DIAGNOSIS OF LESIONS OF THE INNER EAR AND CEREBELLUM.

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Nystagmus is the name applied to any oscillating movements of the eyeballs. It is a reflex and is involuntary, though cases of voluntary nystagmus have been reported. Observation has shown that all oscillating movements of the eyes are not of like character, but that all can be classed under two distinct and separate groups. The first is the undulating nystagmus. In this, both movements, the excursion from and the return to any fixed point, are equal both in extent and in velocity. The second is the rhthymical nystagmus. In this, the movements are not undulating, but follow each other with a distinct jerking motion. Closer observation reveals that in this second variety a cycle (the departure from and the return to a fixed marginal point) is composed of two distinct movements; one fairly slow and deliberate, the other quick and jerky, but both of equal extent. Successive complete cycles are equal as regards time, that is, the time of the slow plus the time of the quick component in one cycle is equal to that of any other, and the nystagmus is therefore called rhthymical. In addition, the nystagmus may be designated as horizontal, rotatory, vertical or oblique, names which will be referred to later. With the first or undulating nystagmus this paper is not concerned, but consideration will be devoted entirely to the second or rhthymical nystagmus; its experimental production, distinguishing characteristics, and observation in pathologic conditions.

TERMINOLOGY.

As before mentioned, the rhthymical nystagmus possesses certain definite characteristics. First of all, it consists of two movements, a rapid and a slow. The rapid movement or com-

ponent may be in any direction, though it is usually to the right or left. The slow movement would accordingly lie in the direction opposite (the left or right). This direction of the quick component is important from a diagnostic point of view, as the nystagmus is designated as nystagmus to the right, or nystagmus to the left, according as this quick component falls to the right or to the left side. It is further designated as horizontal if the plane of the movement lies in or parallel to a second plane passing through the pupils of both eyes. It is called vertical if the plane of the nystagmus is at right angles to this plane, and oblique if the plane of the movement intersects the horizontal plane at less than a right angle or 90°. We still have a variety of frequent occurrence, the rotatory nystagmus. If we conceive of two meridians passing vertically through each pupil, nystagmus of a rolling character will be designated as rotatory nystagmus to the right, of a rotatory nystagmus to the left, according as the quick component impels the upper end of this supposed meridian to pass to the right or to the left. In addition to the above mentioned pure varieties, we may have also a variety of combinations, that most frequently observed being a combination of the rotatory with the horizontal.

Within the limits of the present paper, it would be impossible to consider the various theories of the cause of nystagmus and the paths, afferent and efferent, together with the centers through which the impulses are transmitted; but we will proceed at once to a study of experimental nystagmus and then to a study of that noticed in pathologic conditions, with some reference to the application to the pathological of the principles derived from the experimental.

NYSTAGMUS FROM TURNING.

If a subject is placed upon a revolving stool in the sitting posture and turned to the right, that is clockwise, the hands moving in a horizontal plane, the following phenomena will be observed: During the turning there will be a slow movement of the eyes to the left (in the direction opposite to the turning), and this slow movement to the left will be followed by a quick and jerking movement to the right (in the direction of the turning). If now the turning is stopped and the movements are again observed, we will find that the quick component

is directed not to the right, but to the left, and that the slow component is directed to the right. In other words, we have a complete reversal of the conditions previously observed—a nystagmus to the right replaced by a nystagmus to the left. The observation of the nystagmus during the turning can only be accomplished by placing the patient upon a revolving platform sufficiently large, so that the observer can take his position on the platform at the same time. This involves not only considerable inconvenience, but also much space and fairly costly apparatus. Observation is accordingly practically limited to the nystagmus present after the turning has ceased. This is not in reality an observation of the nystagmus, but of the after-nystagmus, though results obtained from it are quite as valuable and instructive as those obtained from the nystagmus itself.

If we observe this experimental nystagmus still further we notice other characteristics. If, as before, we revolve the patient to the right, obtaining thereby, on cessation, a nystagmus to the left, we may find this nystagmus very slight if the glance of the patient is directed straight ahead. It will reach its maximum if the patient converges both eyes on the finger tip, held say twelve inches from the eye and in the extreme left position, but will disappear entirely if the glance is directed to the right, though the eyes are still in convergence. In other words, glance in the direction of the quick component increases the nystagmus; glance straight ahead, or in the direction opposite to the quick component, weakens it or causes it to disappear. In many cases the nystagmus may be very slight and may be better observed if a strong light, as from an ordinary head mirror, is thrown directly into the eyes.

Alterations in position of the head during the motion give alteration in the nsytagmus. For example, tilting the head strongly forward at an angle of 90 degrees to the axis of the body or the axis of motion gives rotatory nystagmus, while tilting the head to the right or left shoulder changes the nystagmus to vertical. Different varieties of nystagmus also give different sensations. The sensation of turning produced during the horizontal nystagmus is replaced by a sensation of falling if the nystagmus is vertical, and tilting with turning if the nystagmus is oblique.

It is a matter of common experience, that continued turning gives both during the turning as well as after its cessa-

tion, first of all, a sensation of dizziness. The objects may seem to revolve about the observer or he himself may seem to revolve as well. If the turning has been extreme, this dizziness is followed by nausea, vomiting, disturbances of equilibrium, and even loss of consciousness. These sensations are frequently varied in children by placing one ear on the top of an upright cane and running rapidly about it. This would be equivalent to placing the head on the shoulder and would give a sensation of falling, with vertical nystagmus as previously described.

NYSTAGMUS DURING MOTION.

If one sits in a railway coach and looks out of the window, for example, with the right side directed toward the engine or in the direction of motion, he himself will of course be moving from left to right; the objects on the ground will seem to be moving from right to left. If he now fixes successive objects in passing them, and keeps them within the limits of his vision as long as possible, there will be observed a slow movement of the eyes in the direction of the moving objects—from right to left. This slow movement will be followed by a quick movement in the direction of the advancing train, or from left to right. There will be, in other words, a nystagmus to the right. Similar results will follow if the observer stands upon the ground and faces a train passing to the left, fixing successive objects on the train as it passes him.

CALORIC NYSTAGMUS.

Experiments with heat or cold are best performed with large perforations in the tympanic membranes, though good results may also be obtained in experiments on those in whom the membrana tympani is still intact. For this purpose, a Hartman attic syringe is used. Attached to the syringe is a rubber tube one or two feet long and armed with a Politzer bag filled with hot or cold water. If hot water is used, it must be above the body temperature and below 110 degrees, the usual maximum point of toleration, though higher degrees may be borne by some patients. Cold water at a much greater variation from the normal is easily borne. For this reason, nystagmus can be produced by cold in many cases in which hot water produces no effect whatsoever.

With the apparatus above described, let us now inject the right ear of a patient with hot water. This is usually performed by an assistant while the observer faces the one observed. After the injection has proceeded for some moments, the length of time varying somewhat in different individuals, if the patient's glance is directed toward the right, the side of the injected ear, a quick rolling movement of the eyes toward the right side will be observed. This quick movement toward the right will be followed by a slow movement of equal excursion to the left. We have produced experimentally a rotatory nystagmus to the right. Substitution now of cold for hot water gives the opposite nystagmus or nystagmus to the left. Similar results may be obtained by syringing the opposite ear. Hot water then in the right ear gives the same result as cold water in the left and vice versa. If now both ears are injected under like conditions with water of the same temperature, we obtain no nystagmus at all. It is interesting in this connection to note that water at say a temperature of 105 degrees, which has previously produced a well-marked nystagmus in an individual, will produce no nystagmus at all if the patient is suffering with an abnormally high temperature, for example, 103 or 104 degrees. The variation from the body temperature is too slight to produce any marked reaction.

Usually if the nystagmus is marked, dizziness, together with loss of equilibrium, is an accompaniment. This fact may explain an observation of frequent occurrence both of the general practitioner as well as the specialist. On syringing the ear of a patient for the removal of impacted cerumen, especially if the injection has been long continued, the patient will not infrequently complain of dizziness and on rising he may for a few minutes be unable to cross the floor without staggering or even falling. This might be a result of either the abnormal heat or cold or of the pressure as well. That nystagmus from heat or cold apart from pressure can be produced however, can easily be shown by substituting for the water, hot or cold air or ether fumes.

PRESSURE.

Nystagmus can be produced by compression or exhaustion of the air in the external canal or even by pressure on the tragus, as in cases of labyrinthine fistula. It can also be produced by direct pressure on the head of the stapes. The

movements in many cases are exceedingly small and in others entirely wanting. There is no uniformity in the results obtained so that this method at present is of little advantage from a diagnostic view-point, except in the examination of cases of suspected openings into the semicircular canals.

GALVANIC NYSTAGMUS.

If the anode or positive pole of a galvanic battery, armed with a small electrode, is placed upon the right tragus, and the kathode or negative pole, armed with a large electrode, is held in the hand of the patient, during the passage of fifteen to twenty milliamperes of current, nystagmus can easily be produced. This will consist of a quick rolling movement of the eyes to the opposite or unstimulated side and a slow return to the right or side of stimulation. The nystagmus, however, will only be observed with glance to the extreme left (in the direction of the quick component) and not when the glance is straight ahead or to the right. It will not be pure rotatory in character, but mixed with this element will be a slight horizontal element as well.

Anode to the right ear then gives nystagmus to the left. If now the electrodes be transposed, the kathode being placed upon the ear while the anode is held in the hand, the resulting nystagmus will be reversed. The quick component will be toward the right, the slow toward the left, and the nystagmus will be observed only when the eyes are in the extreme right position. Instead of nystagmus to the left, we have now a nystagmus to the right. By comparing the results previously obtained with heat and cold, we find that the anode has the same effect as syringing the ear with cold water, the kathode the same as syringing with hot water.

Patients with galvanic nystagmus show a well-marked reaction. If placed in the Romberg position, that is, in the standing posture with eyes closed and feet together, with nystagmus to the left they fall to the right; with nystagmus to the right they fall to the left. In other words, they fall in the direction of the slow component. Turning the head about a vertical axis, to the right or left, will cause them to fall either forwards or backwards, according as the slow component falls in either of these directions.

PATHOLOGIC CASES.

We come finally to a study of pathologic cases—to an application as it were of some of the observations already made. Possibly the subject may be made clearer by an hypothesis and an illustration.

Let us take a uniform bar, for example, six feet in length, and balance it at the center. Now let us suspend from each end a weight of ten pounds. The bar will remain in balance. This balance may represent the equilibrium of the normal eyes in which no nystagmus is present; and the ten pounds the aggregate stimuli coming from both sets of semicircular canals. If the ears are normal, these stimuli will be equal, and the eyes will remain at rest. To the right arm of the bar let us now add a weight of one pound. The bar no longer remains at rest, but declines sharply to the right side. So with a labyrinthine fistula on the right side, and with it a circumscribed inflammation, we have an increase of the stimuli coming from the right vestibule and there results a nystagmus to the right. This nystagmus will be rotatory and rhythmical in character and will be increased by vision to the right or in the direction of the quick component. Let now this circumscribed inflammation become diffuse, thereby destroying completely the function of the right semicircular canals, or let them be obliterated by operative interference, and the nystagmus previously directed to the right is at once changed to a nystagmus to the left. Here, as the result of all stimuli from the right vestibule being lost, the nystagmus is extreme and manifests itself not only with vision to the left, but with vision straight ahead and to the right as well. This extreme nystagmus persists for some days. It grows gradually weaker, however; first the nystagmus with vision to the right is lost, next that with vision straight ahead, and ultimately, after a much longer interval, the nystagmus with vision to the left. We have in such cases a quantitative estimate of the nystagmus. Returning to our illustration of the balanced bar—the weight of eleven pounds on the right arm has been completely removed and the counterweight on the left arm is unopposed. The bar assumes the vertical or extreme position. As the organism gradually becomes accustomed to the loss of stimuli from the right side; as eyes, cerebellum and muscles compensate for the loss of stimuli from the right vestibule, the result is a gradual return to the normal. The nystagmus, and with it the dizziness, dis-

appears. We can represent the condition with the bar by gradually decreasing the weight upon the left arm. When all weight has been removed, the bar again assumes the horizontal or first position.

In a condition of hyperirritation, as in a suppurative otitis with circumscribed inflammation following labyrinthine fistula, if the left ear was normal, the persistence of function of the labyrinth on the right side could easily be demonstrated. Water above body temperature would increase the nystagmus, water below body temperature would cause it to diminish in intensity or even to disappear. After destruction of the labyrinth by operation or by diffuse suppuration, neither heat nor cold would produce any effect whatever, though the ear would still react to the galvanic stimulation. We might conclude from this, that the destructive process had involved the endings of the vestibular branch of the auditory nerve, but not the nerve fibers themselves.

In these cases of irritative lesions, followed by destruction of the labyrinth, the position in bed is interesting, characteristic and also of diagnostic importance. The patient has an irritative lesion on the right side and with it a nystagmus to the right. He lies on the right side with face toward the pillow. In this position, the eyes are involuntarily turned toward the left or from the pillow—the nystagmus and with it the consequent dizziness and discomfort are decreased by so doing. If now the function of the right labyrinth is destroyed, there results a nystagmus to the left. The causes which formerly induced him to lie on the right side now impel him to reverse his position. As the nystagmus gradually disappears the patient again assumes the usual position in bed and manifests no preference for any special position.

Ear nystagmus then possesses the following characteristics:

(1) It is rhythmical in character—successive cycles being equal as regards time and extent.

(2) Each cycle consists of two distinct movements, a quick and a slow. The nystagmus is also of the rotatory type, though we may have the horizontal as well or even a combination of the two.

(3) Glance in the direction of the quick component increases the nystagmus; glance in the direction of the slow component lessens or destroys it.

If we now compare experimental nystagmus with that ob-

served in pathologic conditions, we note the following points of similarity: hot water injections, kathode stimulation and irritative lesions all give nystagmus to the stimulated or diseased side; cold water injections, anode stimulation and destructive lesions all give nystagmus to the opposite or sound side. We may conclude then that heat and kathode stimulation, being similar in their effect to an irritative lesion, cause an increase in the stimuli from the labyrinth involved; while anode stimulation and cold, acting similarly to destructive lesions, cause a decrease of the stimuli; they exercise, as it were, a benumbing or paralyzing effect upon the labyrinth with which they come in contact.

NYSTAGMUS IN CEREBELLAR DISEASE.

As in vestibular disease, so also do we find nystagmus in lesions of the cerebellum. In these cases, the nystagmus is of extreme value in making a differential diagnosis. Nystagmus of cerebellar origin, is similar to that of peripheral origin. Its seat may be localized in doubtful cases by an exact examination of the function of the vestibular apparatus, that is, by turning, or by injecting hot or cold water. Let us now consider the nystagmus in that disease of the cerebellum most closely associated with labyrinthine suppuration—in cerebellar abscess.

Nystagmus in cerebellar abscess may be toward the sound or toward the diseased side. That toward the diseased side, however, greatly predominates. Cerebellar abscess is usually found in connection with labyrinthine suppuration, so both factors, the labyrinth and the cerebellum, would play a role in producing nystagmus. We must accordingly differentiate among the following possibilities:

(1) With nystagmus to the diseased side, we may have
  (a) A circumscribed labyrinthine suppuration, or
  (b) A cerebellar abscess.

With a circumscribed suppuration, the labyrinth would still be excitable and would react to heat and cold. We would have also the signs of a labyrinthine fistula—aspiration and compression of the air in the external auditory canal would cause movements of the eyeballs. If, however, the reaction from heat and cold was lost, we might still have reaction to pressure and to galvanic stimulation. In this case the diagnosis from the nystagmus could not be made. In such a case,

with nystagmus to the diseased side and reaction to the pressure and galvanism, but not to heat and cold, the labyrinth operation would be performed immediately after the radical. After removal of the labyrinth if the nystagmus, formerly directed toward the diseased side, should then be directed to the sound side, the diagnosis of labyrinthine suppuration without involvement of the cerebellum could be made.

Cases of cerebellar abscess in the experience of the Politzer clinic do not occur in connection with circumscribed labyrinthine suppuration, but with labyrinthine suppuration of a diffuse or general character. To carry our supposition then still further, if, after operation upon the diseased labyrinth, a nystagmus was still directed to the diseased side, and did not change toward the sound side, then the nystagmus must come from some intracranial origin. For a sound vestibule, if the opposite vestibule is destroyed and the cerebellum is not involved, must always cause a nystagmus to its own side.

Our first hypothesis was with a nystagmus to the diseased side and vestibule still reacting. Our second hypothesis is

(2) With a nystagmus to the diseased side and the vestibule no longer capable of stimulation.

In this case, the nystagmus to the diseased side must be intracranial, and this intracranial stimulation must be greater than the stimulation from the opposite and intact vestibule; for, as shown before, if unopposed an intact vestibule will always cause a nystagmus to its own or to the sound side. The nystagmus to the diseased side could only point to a diagnosis of cerebellar abscess. In such a case, due attention would, of course, be given to pulse, temperature and the remaining points in the diagnosis of cerebellar involvement.

There exists now a third possible combination of nystagmus with suspected cerebellar abscess.

(3) The nystagmus is not toward the diseased, but toward the sound side and the labyrinth is not excitable.

The nystagmus here could be of either vestibular or intracranial origin and diagnosis from the nystagmus could not be made. In this case the cerebellar suppuration would have proceeded so far that all function of the cerebellum on the diseased side was lost.

If only the labyrinth is diseased, after operation the nystagmus is extreme and is directed to the sound side. As before mentioned, it decreases gradually and ultimately disappears.

If, however, a cerebellar abscess is associated with the labyrinthine suppuration, the nystagmus after operation does not decrease in intensity, but increases instead. It is reversed and directed toward the diseased side. In this case its intracranial origin can be diagnosed with certainty.

CONCLUSIONS.

Semicircular canals and cerebellum both play a joint part in the perception of equilibrium. That other factors participate strongly is shown by the return to the normal after loss of stimuli from these organs.

Disturbances in the function of vestibule and cerebellum cause disturbances of equilibrium and also produce a nystagmus having certain definite characteristics. We might represent the condition graphically, as follows:

	Right.		Left.
(1) Normal	vestibule + normal cerebellum	=	normal vestibule + normal cerebellum.
(2) Stimulated	vest. + normal cerebellum	>	normal vestibule + normal cerebellum.
(3) Destroyed	vest. + normal cerebellum	<	normal vestibule + normal cerebellum.
(4) Destroyed	vest. + stim. cerebellum	>	normal vestibule + normal cerebellum.
(5) Destroyed	vest. + dest. cerebellum	<	normal vestibule + normal cerebellum.

(2) Would represent the condition in a circumscribed labyrinthine suppuration on the right.

(3) Would represent the condition in a diffuse labyrinthine suppuration on the right.

(4) Would represent the condition in a destroyed vestibule with cerebellum abscess on the right.

(5) Would represent the condition in a destroyed vestibule with destroyed cerebellum on the right.

This paper can only be offered with an apology. Many things of importance are only mentioned—others, for example, the disturbances of equilibrium and the question of nystagmus in the deaf and dumb and the signs of labyrinthine involvement in Meniere's disease are not even referred to. But it has seemed essential to me for any clear understanding of the subject to give at first as it were, a bird's-eye view of the whole rather than an exhaustive discussion of a single part—the only alternative possible in such a paper. The subject of nystagmus with reference to diseases of the ear is still in its infancy and the problems associated with it cannot help but increase both in number and importance as time goes on.

In conclusion, I wish to express my thanks to Priv. Doc.

Heinrich Neumann and Dr. Robert Barany, assistants in the clinic of Hofrath Prof. Dr. Politzer in Wien.

I wish also to mention the articles, "Der Otitische Kleinhirnabszess," by Dr. Neumann, and "Untersuchungen ueber den vom Vestibularapparat des Ohres reflektorisch ausgeloesten rhythmischen Nystagmus und seine Begleiterscheinungen," by Dr. Barany. These two articles I have used freely, and that of Dr. Neumann with reference to nystagmus in cerebellar abscess I have quoted in part. The article by Dr. Barany contains an exhaustive list of the literature on the subject.

XVII.

VACCINE THERAPY IN OTOLOGY AND RHINO-LARYNGOLOGY.

By Robert Levy, M. D.,

Denver.

The study of immunity to and protection against disease followed by its natural application in the development of vaccine therapy opens up a field for thought and scientific research which is practically limitless. Based upon the utilization of natural physiologic function, vaccine therapy, if considered in its purely theoretic conception, presents a vista of beautiful pictures of prophylactic and remedial results offered by no other therapeutic invention. The bacteriologic study of this subject is replete with interest, but so technical and profound that only the student trained in this department of science can grasp its numerous problems. As otologists and laryngologists we are chiefly concerned in its clinical aspects and practical application. It becomes our duty, however, to familiarize ourselves to some extent at least with the fundamental theories upon which treatment of diseases by this method is based and its rationale.

Richardson[1] states that the great mass of bacterial diseases still remains outside the antitoxin category and that speculation has been forced to seek other theories to explain immunity acquired after infection with various cocci. Trudeau[2] calls attention to the unsatisfactory state of this question by outlining the position assumed by the two theories at present in vogue, namely, that of the specific immunity to the action of the microorganism itself and that of the immunization to the chemical poison of the microorganism. In the first a stimulation of our defensive resources is attempted. In the second toxin tolerance is to be desired. In this connection it must be remembered that antitoxins are applicable only to soluble toxins, as in the cases of diphtheria and tetanus, but that for endotoxins which are insoluble, the leucocytes play

an important role and the antibodies here required represent agglutinins, preciptitins, bacteriocidal and bacteriolytic substances and opsonins. The application of our remedy, both as to indication for its use and its dosage, might be made fairly accurate could it be definitely demonstrated by which of these theories practical results had been obtained. It was hoped that Wright's opsonic index might prove a reliable method of measuring the degree of resistance or immunization existing in the organism during an infectious attack. Judging from the rapidly growing sentiment that the opsonic index is of comparatively little value because of lack of standard, we are placed in the unsatisfactory position of depending upon clinical evidence and empiricism. A clinical study may, however, assist in clarifying the subject to a limited extent, so that we may be enabled to calmly pursue further investigation with neither too optimistic enthusiasm nor too pessimistic condemnation.

The results of treatment by vaccine therapy must at this time be considered as sub judice, especially when it is remembered that but a comparatively short time has elapsed since this method has been advocated and because of the limited experience of individual men. No definite conclusions can, therefore, be presented, and when our Chairman requested me to present a paper upon this topic, I consented reluctantly and only with the understanding that I might be permitted to outline no positive deductions but simply the united experience of our colleagues in my immediate vicinity. My paper, therefore, presents an exposition or reflection of the work of men in a limited section of our country.

To this end a carefully considered letter was addressed to our confreres in Colorado, asking for certain definite information covering the important questions relating to vaccine therapy in diseases of the ear, nose and throat, with more or less complete report of cases. I was gratified and surprised at the number and completeness of the reports, especially when we consider that this method is used only in exceptional cases and is rarely undertaken except where operation has failed or has for some reason been deemed inexpedient. It has therefore been extremely difficult to tabulate in a uniform manner the cases so reported; nevertheless, representing the experience of many, and uninfluenced by individual bias, I hope the report may be of some practical value.

The total number of cases reported were 121, divided as follows:

Ear cases 48
Accessory sinus cases 15
Tuberculosis cases 58

The ear cases were divided as follows:

	Cured.	Improved.	Not Improved.	Total.
Acute Purulent Otitis Media,				
With mastoid involvement....	11	1	1	13
Without mastoid involvement..	8	..	3	11
Chronic Purulent Otitis Media,				
Without mastoid involvement..	13	6	5	24
Total	32	7	9	48

All of these cases received the usual conservative treatment, such as drainage and irrigation. Many of the mastoid cases were operated. In a number of cases secondary operations were performed. The most striking results were obtained in those cases in which unhealed mastoids existed, manifesting themselves in recurrences after a greater or shorter period of time.

The sinus cases were divided as follows:

	Cured.	Improved.	Not Improved.	Total.
Antrum of Highmore.....	2	3	..	5
Frontal sinus	2	1	2	5
Frontal and antrum.....	1	2	..	3
All sinuses	..	..	1	1
Antrum and ethmoid	1	..	..	1
Total	6	6	3	15

All of these cases were chronic in their nature and had received prolonged and faithful treatment by drainage and irrigation. Many of them had been operated upon as often as three times, the operation being usually conservative in character.

The tuberculous cases were divided as follows:

	Cured.	Improved.	Not Improved.	Total.
Pharyngeal tuberculosis	2	..	7	9
Laryngeal tuberculosis	3	16	30	49
Total	5	16	37	58

Many of the cases of tuberculosis reported were not considered and have not been entered in this table because of insufficient data. All the tuberculous cases received other treatment, medicinal, surgical and hygienic of the nature usually adopted in tuberculosis.

Other cases reported were as follows:

One case of tuberculosis of bronchial gland pressing upon the right recurrent laryngeal. Cured. (Cooper, Mitchell.)

One case of pharyngeal tuberculosis with suppurating cervical glands. Pharynx cured. Glands greatly improved. (Levy.)

One case of syphilitic necrosis of orbit with involvement of all sinuses. Acute sepsis. (Streptococcus.) Death. (Matthews.)

One case of acute laryngeal perichondritis. Thyrotomy, removal necrosed tissue. Pseudo-diph. bacillus. Cured. (Dennis.)

Of 63 cases exclusive of tuberculosis the reporters gave the nature of the infecting organism in 59. Of these there were cured 35, improved and not improved 24.

The infecting organisms were divided as follows:

Cases Cured.	*Improved and Not Improved.*
Pneumo., Staph. 7.	Pneumo., Staph. 3.
Staph. 8.	Staph. 8.
Strep., Staph. 3.	Strep., Staph. 3.
Pneumo. 3.	Pneumo. 2.
Strep. 3.	Strep. 2.
Pneumo-strep., Staph. 3.	Microc-Catarrh., Strep. 1.
Pneumo-strep. 5.	Pfeifer 1.
T. B., Staph. 1.	Staph., Pyocyan. 2.
Pseudo-diph. 1.	Pseudo-diph., Strep. 1.
Pseudo-diph., Microc. Catarrh. 1.	Pyog. Aureus, Coli Com. 1.

The long period over which bacterial diseases continue is explained by Wright (Matson)[8] by finding that the opsonic power hardly varies from day to day or remains uniformly low. The practical application of this is in the necessity of prolonged treatment.

Another important consideration is in the desirability of isolating the specific microorganism. Failure to accomplish this has resulted in the use of mixed vaccines and where results have not been obtained repeated re-examinations have discovered other bacteria, a vaccine of which proved more satisfactory.

One of the weakest points in bacterial therapy is the question of proper dosage, both as to amount and frequency thereof. This has been especially pointed out by Matthews.[4] One can not be guided entirely by the opsonic index because of the fact that this is subject to such variations as to make it a source of error. On the other hand, clinical evidence alone must be unsatisfactory because of *its* many sources of error and its misinterpretation. Nevertheless, careful clinical observation has been of more uniform value than laboratory reports.

In administering repeated doses one must not forget the liability to sensitization. Bergey[5] has given us some interesting experiments bearing upon this point, but draws the conclusion that the dangers are remote because the dose of bacterial vaccines is usually too small. This danger applies more to serum theapy than to vaccine therapy. The failure of response to bacterial therapy depends also upon the character of the infection. Harris[6] has shown that in nasal and throat affections the micrococcus catarrhalis produces unyielding conditions, but believes the influence of foreign particles irritating the mucous membrane prevents accurate deductions. Ohlmacher[7] shows that certain combinations of bacteriologic species are particularly obstinate in their reaction to therapeutic inoculation, and speaks especially of a combination of bacillus pyocyaneus with other pyogenic species.

Particular interest attaches to the treatment of tuberculosis in general and for us, especially in lesions of the ear, throat and nose. The local reactions which have followed tuberculin injections have been watched with much interest. Trudeau[8] has found pain and aphonia in laryngeal cases. I have seen swelling and redness of the local lesions in both pharyngeal and laryngeal tuberculosis following the use of tuberculin. Trudeau has also concluded that slight local reactions were followed by reparative changes. The ultimate result upon tuberculosis of the upper air passages and ear are necessarily modified by the coexistence of pulmonary or general tubercu-

losis This is especially forceful when we remember that primary lesions of the upper air passages rarely if ever occur. Nevertheless, the report of our cases shows that permanent cure of local lesions may take place under vaccine therapy, but not sufficiently often to warrant the conclusion that we have at our command a specific remedy. Tod[9] has reported improved hearing in tuberculous ears following inoculation. Cases found in the above report show occasional complete and frequent temporary cessation of discharge in tuberculous otitis. In these, tubercle bacilli were not always found but tuberculin was given with autogenetic vaccine.

Beck's[10] cases show encouraging results. Goadby[11] relates remarkable improvement from vaccine therapy in antrum cases.

Investigations in the treatment of all bacterial diseases of the upper air passages are being carried out, such as recurring colds, atrophic rhinitis, influenza and chronic nasopharyngitis, but as yet evidence is too indefinite to warrant any conclusions.

My observation and experience leads me to advise that all obstinate cases in which conservative methods, including so-called conservative operations have been adopted, should receive the benefit of vaccines This refers to all ear cases, chronic, acute, with or without mastoid involvement, and all accessory sinus cases.

In the study and preparation of this paper, I have had the assistance of the bacteriologists in my section of the country, namely, Drs. Webb of Colorado Springs, Peebles of Boulder, Mitchell and Matthews of Denver, as well as the most generous and unselfish support of the following men: Drs. Bane, Carmody, Cooper, Foster, Lockard, Strickler, Bonney, Berlin of Denver, Magruder[12] the first to report ear cases treated by vaccines, Patterson, Sollenberger, Dennis of Colorado Springs, and Spencer of Boulder. They have freely permitted me to use their cases, many of which are incorporated in this report.

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XVIII.

OPERATION FOR MALIGNANT GROWTHS OF THE TONSIL.*

By Dr. Karl Vohsen,

Frankfort on the Main.

Translated by Wm. Baron, M. D.,

St. Louis.

Operations on malignant growths with their accompanying involvements of the pharynx and base of the tongue, demand a method of procedure which allows the operator a full view of the parts and permits of controlling incidental hemorrhages.

The simple enucleation of the tonsil may be considered justifiable only in those rare cases in which there is a small tumor confined entirely to the tonsil, where subsequent examination proves an intact capsule of the tumor. But even in such cases, slightly diseased, still impalpable lymphatic glands may exist whose presence would have been revealed by an external operation.

The early stages of these tumors generally escape our diagnosis. It may be considered fortunate when the patient comes to us as soon as he notices the growth of the tonsil. He consults us, as a rule, because of pressure pains toward the ear or because of difficulty in swallowing, and then the conditions arouse suspicion that the swelling has encroached on the anterior and posterior pillars, the tongue and adjacent lymphatics.

For the purpose of operating on these tumors, Langenbeck introduced the temporary resection of the inferior maxilla, and this method of exposing the lateral parts of the pharynx has since been the mode of procedure of all operators.

*Read before the International Congress of Rhinology and Laryngology, Vienna, 1908.

Kocher in his "Operationslehre," 1907, thus describes the osteoplastic resection for exposing the upper parts of the pharynx: "After obliquely cutting through the inferior maxilla, from the back, inside and top toward the front, outside and bottom, the ascending ramus is drawn firmly upward and the horizontal ramus is drawn forward, at the anterior margin of the masseter." (p. 192.)

In conjunction with numerous modifications of the cutaneous section, assembled and illustrated by Hensell of the Czerny klinik (*Brun's Beitraege zur klin. Chirurgie,* Bd. 14, 1895), this method of resecting and drawing apart the resected parts of the inferior maxillary remains practically the same.

Only Mikulicz (*Deutsche med. Wochenschrift,* 84-86) and Kuester (ibid. 85) have resorted to another method, having recourse to a total resection instead of an osteoplastic resection of the ascending ramus. Mikulicz specifies as a marked advantage of this procedure "the complete and easy exposure, exteriorly, of the lateral wall of the pharynx and the possibility of carrying out the operation almost to its end *extra cavum pharyngis et oris.*" Kuester emphasizes among other advantages of this method of operation that ankylosis of the temporomaxillary joint is avoided, which need not be apprehended at all in the Mikulicz procedure. Kuester subjoins to his description: "It is not to be denied, however, that this method has its drawbacks. The jaw is set obliquely, as both musculi pterygodei are withdrawn and those of the opposite side crowd the maxilla toward the affected side. The power of the mandibular muscles is decreased, as all of the mandibular muscles of the affected side, the masseter, the temporalis and the pterygodei, lose their points of insertion. It is true that Mikulicz has limited the detachment of these muscles by the recommendation that the section of the maxillary be made above the masseter, but even this does not remove the objections raised by Kuester. The viewpoint advanced by Kuester, that of avoiding ankylosis, seems of great moment in cases where the tumor has encroached on the fold between the superior and inferior maxillae, and in such an event, the Mikulicz method would seem to be the one to be preferred to all others.

The cutaneous section of the Mikulicz method extends

from the mastoid process of the temporal bone to the greater cornu of the hyoid bone and is serviceable in exposing and extirpating metastically affected glands along the sternocleidomastoid and the carotid sheath. In practicing osteoplastic resection it has been found, as an offset to total resection with the above described consequences, that in order to expose the field of operation to the opening of the larynx it was necessary to sever the diagastric, the stylohyoideus and the nervus hypoglossus. In a great many cases preliminary tracheotomy was performed in addition, so that temporary resection, as practiced up to the present, as well as total resection according to Mikulicz, requires a number of serious lacerations, which can only be attributed to the method of operation.

Now, I wish to demonstrate that the same final results may be accomplished with fewer lacerations. I can refer to a case in which I performed the operation to be demonstrated, on a living subject before the association of physicians at Frankfort-on-the-Main. It was a case of a large sarcoma of the left tonsil, encroaching on the lateral base of the tongue, with metastically affected lymphatics of the neck.

Five months ago, a man of 23, still serving his military term, felt a tickling sensation in his throat which incited vomiting. Healthy up to 7 weeks prior to examination, when he noticed an obstruction in the left side of his throat which made swallowing difficult. Appetite, sleep, stools good. No hereditary history. Parents alive. Three healthy brothers and sisters. No peculiarity of nose. Good teeth. Lungs and heart without anomalies. The left tonsil has become a superficially ulcerated swelling, the size of a small apple, rounding out the anterior part of the soft palate very considerably. It drops down over the left side of the basis linguae and obstructs the view into the larynx. The upward view is obstructed by the protuberance of the velum palati, but the still intact os tubae may yet be perceived. Slightly increased size of the pharyngeal tonsil. A large, coarse, painless, movable gland about the size of a plum lies before the upper third of the sternocleido-mastoid. No other gland palpable with the exception of one of the size of a bean in the upper part of the maxillary angle.

An examination by Prof. Albrecht of a specimen taken at a preliminary examination and of the tumor, afterward extirpated, revealed a medium-celled sarcoma, the shape of the cells indicating that it probably originated in the lymph follicles.

The cutaneous section made, according to Mikulicz, from the point of insertion of the sterno-mastoid muscle to the greater cornu of the hyoid bone. This is followed by the exposing of the superficial cervical glands adjacent to the sterno-mastoid, and all such as arouse suspicion extirpated. The skin is drawn firmly forward and up and the inferior maxilla is exposed at the anterior margin of the masseter. At the same time the facial artery is located and pushed forward. The periosteum of the inferior maxilla is cut anterior to the masseter, elevated with the raspatory on the medial side and then, avoiding injury to the medial periosteum of the inferior maxilla, the latter obliquely is sawed through, from above and behind toward the front and downward.

As a preliminary, it is proper to bore the inferior maxilla for the suturing which follows. Then the periosteum of the lower and inside of the maxilla is detached from the line of the cut to the ascending ramus, for the purpose of manipulating it as I shall now describe, which manipulation is the main feature of the new method of operation:

It is now seen that the inferior maxilla, caught with a wide retractor from the back of its ascending ramus, together with uninjured fascia parotideo-masseterica in situ, can now be pushed up, out and forward far enough to accomplish the same result for which Mikulicz resorted to total resection of the lower maxilla. The mandibular joint with its very wide socket permits of very free play of the condyle. The temporalis does not in any way oppose the processus coronoideus. If, after resection, the two parts of the inferior maxillary be not drawn apart as has been generally done up to the present, but if instead, the posterior section of the inferior maxillary be pushed forward, outward and over the anterior part, a vigorous pull on a wide retractor, which catches and draws backward the sterno-mastoid, the stylo-hyoideus and the nervus hypoglossus which appears under the latter, causes a wide space between the front margin of the sterno-mastoid and the

ascending ramus, so that the field is now clear for final operation.

No important blood vessel leaves the carotid artery between the internal and external maxillary arteries along this line, and if it be desirable to expose the region of the tonsils, the interna may be protected, as it is situated up higher. Only the facial vein with its anastomoses requires double ligation. We have now reached the lateral wall of the pharynx. The finger crowds the tumor, which in this case could be bluntly detached, outward from the oral cavity. As in the Mikulicz process, we have up to the present operated *extra cavum oris et pharyngis* in this case, with the exception of the section of the inferior maxilla between the second and third molars, which in this instance does not bleed very much and forms a gap very easily tamponed. Of the more important vessels and nerves, only such as were absolutely unavoidable, the inferior alveolar arteries and nerves of the lower maxillary were severed, which is not detrimental. Eight days after the operation the mucous membrane of the lower lip had regained its sensitiveness. As the preparation demonstrates, the pharynx is splendidly exposed to view. By the proper pull on the retractor the openings of the larynx and the cavum may be seen clearly, so that I consider this method adapted to any manipulation of these parts. In my case the base of the tongue was laterally diseased and had to be partially removed. The arterial supply of the tonsils did not require any ligation, which would, however, have been an easy matter, as the view was entirely unobstructed.

The breathing was not disturbed, as the slight bleeding could be entirely controlled by tamponing the exterior. An exact suture of the wound of the pharynx with catgut and the tamponing with iodoform gauze the wound of the neck (which was nearly closed) followed. The maxilla was sewed with silver wire drawn over the cheek through buttonholes and knotted. The patient was nourished for only three days through a permanent esophageal tube. On the third day he could take liquid nourishment by lying on the healthy side. Beginning with the fourth day the tampon was changed daily and gradually decreased in size. On the 11th day the patient with the external wound healed was brought before the association. The maxilla had knit, the

teeth scarcely lacking normal occlusion in mastication. Later an ulceration developed in the wound of the neck, caused by necrosis of the alveolar process at the point of resection. This would not in all probability have occurred had I extracted the third molar at the time of making the resection, as I was compelled to do later. Up to the present time, seven months after the operation, there has been no recurrence.

This method of operation, the novelty of which consists in pushing the posterior section of the inferior maxilla outward, forward and over the anterior section makes possible an uninterrupted view of the pharynx, cavum and opening of the larynx. It permits the discovery and removal of metastatically diseased glands, injures no muscle, nerve or important blood-vessel and requires no preliminary tracheotomy. It seems to me that it is destined to become the generally used method in removing malignant growths of the tonsils which do not encroach on the region between the inferior and superior maxillaries. For ailments of the latter parts the Mikulicz method seems to be the preferable one, as it makes the avoidance of subsequent ankylosis possible. My method seems to be peculiarly adaptable to the removal of tumors of the cavum, at the base of the tongue and the opening of the larynx, permitting, as it does, an uninterrupted view of those parts.

XIX.

RECENT OBSERVATIONS CONCERNING PHONASTHENIA.

By Dr. Theodor S. Flatau,

Berlin.

Translated by H. Strass,

St. Louis.

The occurrence of a large number of largely serious and chronic cases of phonasthenia has given me the opportunity (since my last publication concerning this disease), to further elaborate its course, and to illustrate it by many characteristics heretofore unknown.

I will not give a description of the early symptoms of this disease, even though this be of particular importance, owing to its insidious beginnings, and the frequent misinterpretations of its connections; the period of its first or earliest development is also often very protracted. Certain forms exist, which take years to develop the earliest symptoms, until destruction and intensified phenomena make recognition easy. I will confine myself to those symptoms selected from material observed during the last few years, and which offer new and important characteristics.

First in line we must mention the pains resulting from this disease.

Connection with the phonasthenic complex of symptoms is plain because of the fact that they accompany the phonetic action, that they are intensified during its proggress, and disappear gradually when it ceases. In addition to the better known phonasthenic throat and chest pains, I have frequently described in detail the phonasthenic neck pain.

As related to these pains we may consider the phonasthenic jaw or maxillary pains, easily distinguished in a number of cases, especially in those of rheseasthenia, by certain well-defined characterstics.

The given cases were all uniform in this respect, that not in one of the maxillaries was found any reason for the pains. The most minute examination of the organs, by means of our own, and also dental aid, failed to discover any reason whatsoever for the maxillary pains.

The intensity of the maxillary pain may increase enormously; beginning in the inferior maxilla, it takes its way across the chin to both sides, embraces both superior maxillaries and loses its way towards the upper part of the head, or combines with the neck pain. The patients themselves describe a laxness or tired feeling of the lip and cheek-muscles. Pressure or pain, or any objective finding, does not exist.

Hyperesthesia and paresthesia within the laryngeal mucosa are also to be considered. While laryngeal pain, particularly in its neuralgic form, is well-known, hyperesthetic conditions, and in the beginning, their resultant reactions, are generally not considered related. The result of hyperesthetic conditions are irritative symptoms which are objectively noticeable. Added to these are the cough irritations, phonasthenic clearings of the throat, the desire to gulp or swallow, and the phonasthenic swallowing.

The course of the phonasthenic cough is often peculiar, and is frequently confounded with that due to a nervous cause. The distinction lies in the fact that the phonasthenic cough, as well as the clearing of the throat, only appear during the phonasthenic action, and are caused by hyper- and paresthetic conditions. This phenomenon may easily be brought about—for instance, causing a singer, suffering from dysodia, to hold a note for some time; especially in the effort caused to hold the tone piano, the described sensation will appear, followed by a phonasthenic cough, which is dry, and only after frequent recurrence is there a slight mucous expectoration. As frequent is the phonasthenic gulping, but inducing no secretion. This phonasthenic gulping is also a little known symptom, in fact, in many cases of this kind, particularly in the earliest stages of phonasthenia, it is frequently not diagnosed as a symptom, special or local treatment being of course without beneficent results. In typically characteristic and serious cases the connection of this phenomena with the disease is easily discovered, because the motions of swallow-

ing and the described irritation appear during phonasthenic action.

I observed a preacher who suffered from this symptom in its most aggravated form. After uttering a few sentences of his sermon, he began to feel the irritation in his larynx. He was obliged to yield to the inclination to swallow. Resuming his lecture, the phenomenon again appeared, and caused such discomfort that he was forced to give it up.

Another case was that of a singer, whose very possibly exaggerated practice of holding back the voice (Stanuebungen), was probably the foundation of his trouble. In all cases of this kind, close observation and functional examination strengthen the diagnosis for phonasthenia, proving the existence of objective and essentially acoustic symptoms of this disease.

We have now arrived at the objective phenomena. To these belong, in the train of phonasthenia, the audible and visible swallowings, gulpings, clearings of the throat and coughs. As belonging to these may be considered those expressions of fear visible on the faces of persons before an attack of phonasthenia, the sufferers being plainly distressed. These symptoms of fear may be so strong as to cause palpitation of the heart, paleness and excessive perspiration. Added to these, in serious cases, may be a sudden cessation of the larngeal motions, a sum of phenomena which I might call "phonasthenic collapse." In a number of serious cases of rhesiasthenia. I have been able to observe patients while they were going about their usual occupations, and at a distance was able to notice in what order the symptoms appeared.

First, the voice became weaker, fainter, the various irritations already mentioned multiplied, expressions of fear appeared, paleness, and beads of perspiration were visible on face, forehead and brow.

A number of times these attacks disappeared, helped by drinks of water taken at regular intervals to induce artificial cessation. In one serious case the speaker was obliged to resort to the blackboard to make himself understood. Laryngeal motion ceases entirely when the symptoms of laryngeal collapse are well developed and appear simultaneously in an attack. In many cases the impres-

sion one carries away after witnessing an attack is anything but pleasant.

Breathing, even articulation continues, while the patient seems to be struggling to regain his voice. In fact, there is a superficial resemblance to stammering. In the cases under my care the progress of the disease was so closely observed that mistake was not well possible, as the symptom appeared only at the height of the combined phonetic collapse phenomena, while gradually the objective phonasthenic symptoms decreased, to completely disappear when a cure for phonasthenia was effected.

Concerning therapeutic development, the methods of treatment described by me some years ago, and adhered to since, have proved of value. Added to these are the combined uses of electricity and vibration. In order to show the workings of this apparatus, I have brought one with me. It is a much stronger machine than the earlier ones, and fitted with removable electrodes. This stronger electrical apparatus was made necessary by the fact that in the more recent employment of electricity for treatment, particularly of the high notes, the faradic current was frequently replaced by the alternating current, with 4,400 interruptions to the second, brought about by use of the Leduc apparatus, and this, as well as the faradic application, combined with my vibrator, also each factor used separately, was applied to the collar-like contrivance here shown.

Other influences were brought to bear on those chronic cases of phonasthenia with pronounced hypokinesthenic functional derangements, and at the same time anomalies of secretion, by quicker and more thorough methods, causing improvement of the circulation and nourishment of the laryngeal musculature. As in other cases of diseased respiratory organs, operative measures have proved useful. Some time ago I called attention, in cases of atrophic rhinitis, to the favorable results obtained by the introduction of foreign bodies, bringing about a radical cure, with permanent increase of tissue and normal secretion in cases of atrophic rhinitis in its fetid form. Right here the suitable application of Bier's hyperemia has been of such service that I would like, in a few words, to speak of this method, which I have used with success to combat cases of phonasthenia.

Measured according to the size of the thyroid cartilage,

the suction cups are applied to both sides in the ordinary way and increased gradually. With gradual increase of pressure I apply suction for three-quarters of an hour. A very thorough permeation of the tissues results, followed in first place by a functional derangement lasting about three days. During this period I usually abstain from using voice gymnastics in treatment. Resuming this, an improvement is noticeable in a few days; for instance, in a case of dysodia in the form of regained upper notes, in the case of objective phenomena, a further abatement of the severe symptoms of pressure and other evils.

This is the principal form of hyperemia used in cases of phonasthenia, though I practice it in still another manner, namely, in a slight case, with mild suctional pressure, proceeding in the following manner: I produce a congestion lasting a quarter of an hour, during this period using a modified voice gymnastic treatment with progressive movements.

Laryngoscopic examination will show that during intonation, by a slight tug at the suction cups, an abduction of the cords may be brought about. It is therefore easy to see the great value of such influences during phonation, when it is a question of removing hypokinetic phonasthenic movements which have become habitual, and on the other hand to further the strength of insufficient action by mild opposing measures.

Judging by the experiences of the past few years, I consider this therapeutic factor of the greatest importance, but do not wish to take the stand that this is to be without question the sole weapon against phonasthenia, for on this subject it will always be well to take into consideration the sum total of factors of a functional therapy, not to consider but one side of it in a mechanical manner.

BOOK REVIEWS.

Chirurgie des Gehirns und Rueckenmarks.

Vol. I. Surgery of the Brain. Price unbound 12 marks. 63 Figures and 23 Colored Plates.

The first volume of Prof. Krause's "Surgery of the Brain and Spinal Cord," which concerns itself exclusively with the technic of surgical procedures on the brain, will be eagerly ready by otologists whose work carries them into this field. Nowhere is it possible, as in this comparatively small volume of 175 pages, to find as much valuable information on a subject which is beginning to interest surgical otologists more and more. Although the work is an expression of the author's personal experience, he has given due credit to the investigations and teaching of Johns Hopkins and Horsley in England.

To ear specialists the chapter on the treatment of abscesses of the cerebrum and cerebellum is by far the most interesting. The various steps of opening an abscess from the primary osteoperiosteal flap to the proper method of tamponing are given with great detail. The position which he takes of never puncturing through the healthy dura is unquestionably correct, and his flap method gives one a more extended view of the field of operation than the haphazard method of destroying a large portion of bone, when the procedure is carried out from the field of the former mastoid operation.

A particularly suggestive chapter covers the disturbances and accidents which may occur during the after-treatment. Bone necrosis, secondary hemorrhage, the escape of the cerebro-spinal fluid and prolapse of the brain substance are fully considered.

The removal of tumors from the region of the auditory nerve is an operation which but few otologists have attempted, but the detailed explanation and the magnificent plates give one a very clear idea of the procedure. Craniocerebral topography is carefully explained and illustrated, and

such important details as narcosis, asepis, etc., are not neglected.

The plates are works of art, the colors true to nature and the text clear and convincing. HORN.

Lehrbuch der Ohrenheilkunde.

BY DR. GEORGE BOENNINGHAUS. S. Karger, Berlin. Price unbound 9.80 marks. With 139 drawings in the text and one colored plate.

In this new text-book of "Diseases of the Ear," Boenninghaus sets a standard which in the future will be difficult to surpass. The work is filled from cover to cover with original ideas and drawings, and brings one at once abreast of everything new in the way of physical examinations. Even Barany's very recent work on the diagnosis of labyrinth disease is fully explained, and the newest theories regarding the functions of the internal ear are clearly and intelligently treated.

The original sketches and new diagrams are helpful and the lecturer and teacher will be able to gather some new points which will tend to clarify and enliven his lecture course.

The arrangement of the text is good, the press-work perfect and the colored plate helpful. HORN.

Die Komplikation der Stirnhoelenentzuendung.

PROF. P. H. GERBER (Koenigsberg). S. Karger, Berlin. Unbound 15 marks. Bound 16.60 marks. With 450 pages text and 36 illustrations.

The magnificent monograph of Gerber's, which has just appeared upon "The Complications of Inflammations of the Frontal Sinus," is the most complete work of the kind in existence and will become a classic on this subject. Although the book has been in preparation for over five years, the work of assorting and bringing together the immense mass of literature was delayed until the moment of its appearance. From cover to cover the scientific exactness which always characterizes Prof. Gerber's work, gives the reader a sense of security and puts him in touch with all the material which can possibly bear on this subject.

A radical attack on the frontal sinus and ethmoid laby-

rhith is at best no child's play, and the individual operator can draw no general conclusions from the few cases he himself has treated. Let an important complication enter the case, and one will be more than thankful if he is in a position to put his finger on the combined experience of the world's best men. It is no compliment to our profession that most of the complicated cases fall into the hands of the surgeons and ophthalmologists.

Gerber criticises, and with a great deal of truth, the loose methods of classifying the diseases of the frontal sinus. He proposes a classification, which is very similar to that of Killian, and which seems accurately to cover the ground:

1. *Antritis frontalis simplex.
   a. Blennorrhea or pyorrhea antri.
   b. Empyema antri.
2. Antritis frontalis abscendens.
3. Antritis frontalis dilitans.
   a. Empyema c. dilatatione.
   b. Mucocele, cyst.

It is impossible to give in a few words the percentage of complications to frontal sinus affections in general. The reasons are clear. It is only very recently that careful post-mortem examinations of the necessary cavities of the nose have been made. The actual percentage is small, but the impression which is gained from the writings of Kuhnt and others is that cerebral complications are much more common than we have thought. In Gerber's 493 cases of disease of the frontal sinus, he found 5 per cent complications.

In Chapter II. on the pathologic changes due to disease of the bony walls of the sinus, in addition to a complete literature on the subject; he quotes 11 cases from his own experience, which illustrate all degrees of bone disturbance from a simple periostitis to caries and necrosis of all the walls of the antrum. Of the rarer complications, 5 cases of cholesteatoma, 14 cases of pneumocele and 29 cases of osteomyelitis have been collected.

The chapter on anatomy is interesting. It is shown that

1. a. Those cases where the discharges empty into the nose.
1. b. Those cases where the discharges have no outlet.
2. Those cases where the discharges have perforated the bony walls of the antrum and collected under the skin.
3. Explains itself.

the percentage of frontal diseases is far greater in men than in women, and much more common on the left than on the right side. An absence of the sinus is found in 5 per cent of all cases. Based on this fact and on other equally well known anatomic grounds, he lays special stress on the point "That all intranasal operative procedures, whether the sinus is present or absent, are more dangerous than the external operation." A point with which most surgeons will agree.

The full treatment allowed to the anatomy of the ductus frontalis and its many anomalies, shows what a matter of overwhelming importance it is to know the pathologic condition of this duct, for on its patency depend largely the course and complications of the disease.

The two chapters on ocular, orbital and intracranial complications occupy the second half of the book. The eye complications are lightly but thoroughly covered, as the matter has often been thoroughly treated in the writings of ophthalmologists. One becomes acquainted, however, with every change that may occur and is put on the outlook for possibilities.

Fully 150 pages are devoted to intracranial complications other than the brain abscess. Of 51 cases of leptomeningitis following inflammation of the frontal sinus, 48 patients died! Need we be on the outlook for trouble or let a case of sinus disease drift along from day to day and not demand operation?

In the chapter on etiology, syphilis is shown to be a factor of but very little consequence, contrary to what has generally been supposed, and the great importance of influenza is clearly proven. The chapter on therapeutics is headed with the sentence "One cannot burn with water or wash with fire," and he is almost completely in accord with Fridenberg (N. Y.), who considers the most radical operation the best. In accord with most of the experienced operators of today, he considers the Killian operation, with some small modifications, undoubtedly the most practical.

Space forbids a more extensive review of this great work, but to a German reading specialist it is a book which is dangerous to be without, and it is to be hoped that a translation will soon be given to English readers. HORN.

Das Gehirn und die Nebenhoehlen der Nase.

By Prof. H. Onodi. Buchhandler, Alfred Hoelder, Wien. Price unbound 10 marks. With 63 life-sized plates and 13 pages of text.

"The Brain and the Accessory Cavities of the Nose" is the fourth of Prof. Onodi's great works on the subject of the anatomy of the nose and its accessory cavities.

As the title indicates, the present work is a series of beautiful life-sized photographic reproductions, illustrating the anatomic relations of the brain to these cavities. The outlines of various frontal sinuses have, by means of the X-ray, been projected directly upon the surface of the brain. One can see at a glance what areas are covered and what enormous and important variations can occur.

In the 1200 skulls examined, an entire absence of the frontal sinus was found in 5 per cent of the cases. A comparison with the author's results obtained by transillumination is interesting and leaves us in no doubt as to the unreliability of this method when used alone. Here 30 per cent. showed an apparent absence on both sides, and 10 per cent. on a single side.

A glance at Fig. 7, showing a right-sided frontal sinus 56 millimeters high and extending over on the left hemisphere, demonstrates at a glance how a right-sided empyema could give rise to a left-sided brain abscess and how necessary a correct outline of the sinus would be in case of an operation.

Only 13 pages of text precede the 63 beautiful plates; the pictures themselves being separately described. Some of the sagittal sections are especially fine and in fact the entire work will win for itself warm appreciation from the anatomist, the teacher and the specialist. Horn.

Beitraege zur Topograpisch-Chirurgischen Anatomie der Pars Mastoidea.

Von Dr. H. E. Kanasugi. Alfred Hoelder, Wien. Price unbound 8.60 marks. Postage 1 mark. Bound 9 marks. With 40 photographic illustrations in the natural size.

This contribution to the topographic and surgical anatomy of the mastoid portion of the temporal bone is the result of a series of investigations carried out by the author on 4000 skulls. The text covers but 25 pages, but the life-

sized photographic plates with the accompanying remarks need no further explanation. Every variation which occurs in the anatomy of this region has been covered and complete bibliography is also given.

The plates are very fine, the frozen sections especially being highly instructive. Probably no work exists where the anatomy is more thoroughly worked out. HORN.